ENGINEERING AND MINING JOURNAL

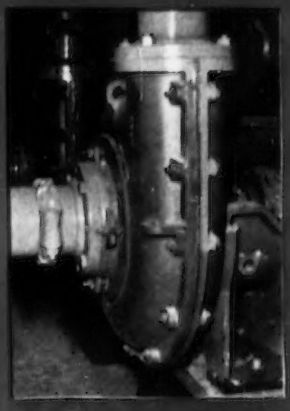
A McGRAW-HILL PUBLICATION

DECEMBER 1957

PRICE ONE DOLLAR

FOUNDED 1866

Canadian uranium mine uses three types of A-S-H pumps



Tailings are pumped by these Hydroseals, which differ from Centriseals only in their rubber engine-side shell half-liners and rubber impellers.

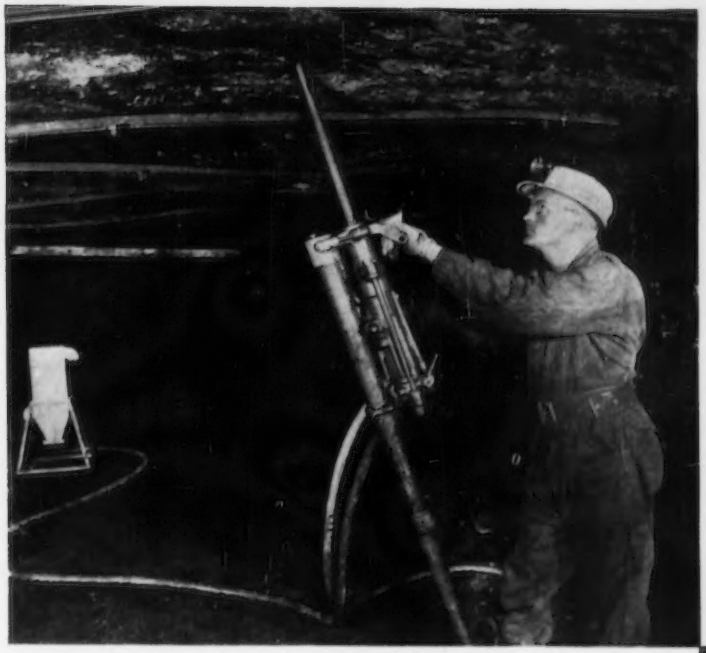
Thirty pumps of the A-S-H line are contributing to efficient operation in this up-to-date mill of Faraday Uranium Mines, Ltd., at Bancroft, Ontario. Where the advantages of Hydrosealing can be applied, the pumps are Hydroseals. In the Filtration and Ion-exchange phases of the process, where slurries and corrosive liquors must be delivered undiluted, they are Centriseals. For drainage and clean-up work, acid-proof Hydroseal Vertical Sump pumps are used.

How many types for you? Write for Brochure No. 357.

THE ALLEN-SHERMAN-HOFF PUMP CO.
Dept. B—259 E. Lancaster Ave., Wynnewood, Pa.
Representatives throughout the World

In Canada, with warehouse stock: **MINE EQUIPMENT COMPANY** *Limited*
MONTREAL TORONTO KIRKLAND LAKE SUDBURY EDMONTON

HYDROSEAL and CENTRISEAL
SAND, SLURRY & DREDGE PUMPS
MAXIMIX RUBBER PROTECTED



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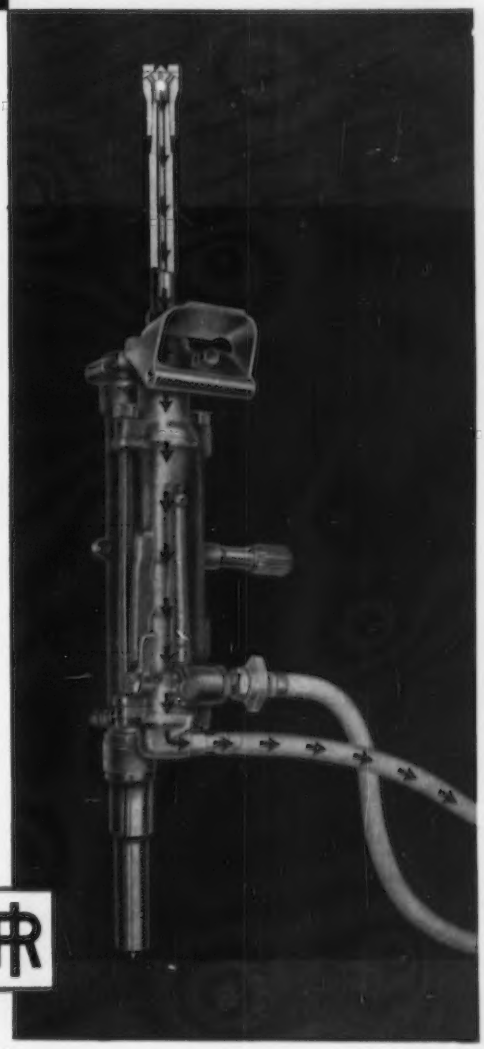
It's the sensational

VACUJET ROOF BOLTING DUSTLESS STOPER

with built-in JET SUCTION
and PRESSURE DISCHARGE



In the new RP38E VACUJET dustless stoper, Ingersoll-Rand has perfected the first practical solution to the problem of dust control for roof bolting and other up-hole drilling operations. It's the *only* stoper that offers you all these important advantages.

Strong Suction Power — vacuum-producing jet ejector built into drill backhead. Can even drill horizontal holes!

Dust Discharged Under Pressure — to a distance of up to 25 ft from drill. Uses ordinary air hose.

Low-Cost Dust Collector — a simple filter and receptacle is all that's required. Even a canvas bag will do.

Quieter Operation — no unnecessary ear-splitting whine or howl in dust collection.

Highest Drilling Speed — because stronger vacuum and larger dust ports assure non-clogging operation.

Lower Bit, Rod and Shop Costs — tapered bit and rod connections eliminate need for furnaces, threading and forging equipment

For the complete story on this revolutionary new VACUJET stoper, call your I-R man or send today for Bulletin No. 4195

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HOSE • JACKDRILLS • IMPACTOOLS

MAXIMIX RUBBER PROTECTED

ENGINEERING AND MINING JOURNAL

91st YEAR OF PUBLICATION

DECEMBER 1957

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B.F.Goodrich report:

Men punch holes in rock to blow up a cliff

B. F. Goodrich improvements in rubber brought extra savings

Problem: Those workmen are drilling holes for dynamite charges, to blast out rock for a dam. It's no cinch to lug a heavy drill down a cliff like that. Too many times it had to be promptly carried up again—the tool had choked to death.

When heat from the compressor got into the hose, it would harden the rubber, breaking it into loose, gummy particles that clogged the air tool, put it out of action.

What was done: B.F.Goodrich engineers went to work on the problem. By adding, subtracting, changing proportions of rubber, they found a special compound that stands hot air, won't harden, crack, or break into gummy particles to clog tools.

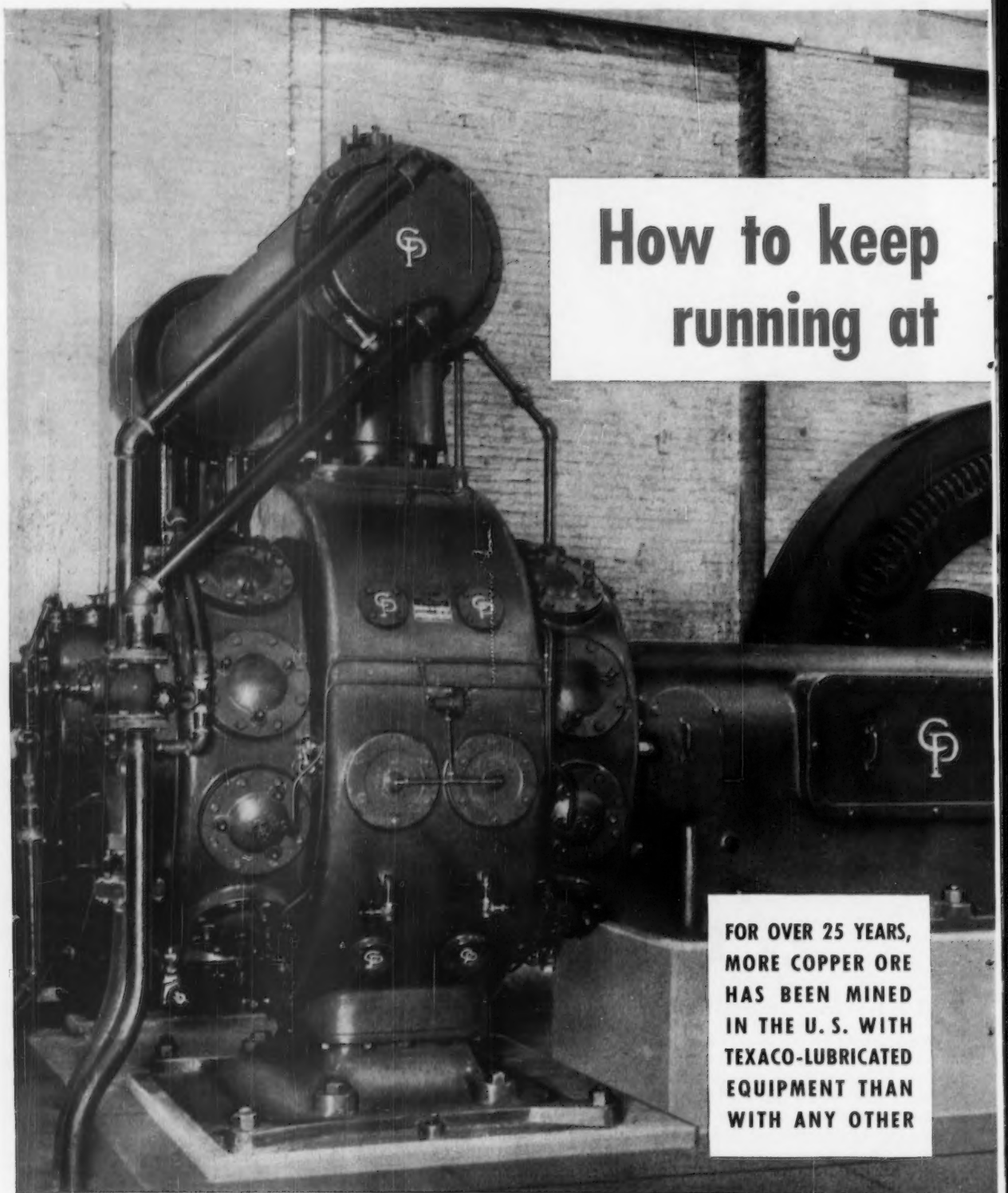
Savings: Hose lined with this new rubber was made and put to work. On jobs where air hose used to go to pieces in weeks, B.F.Goodrich hose lasts months, even years. The nuisance of clogged tools was ended permanently.

Extra benefits: Resistance to heat is only one of the improvements made in this B.F.Goodrich air hose. It has a cover so rugged that dragging over rough rock won't tear it. And it's light, flexible, easy to work with.

Where to buy: Your B.F.Goodrich distributor has exact specifications for the B.F.Goodrich air hose described here. And, as a factory-trained specialist in rubber products, he *can* answer your questions about *all* the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-164, Akron 18, Ohio.*

B.F.Goodrich

INDUSTRIAL PRODUCTS

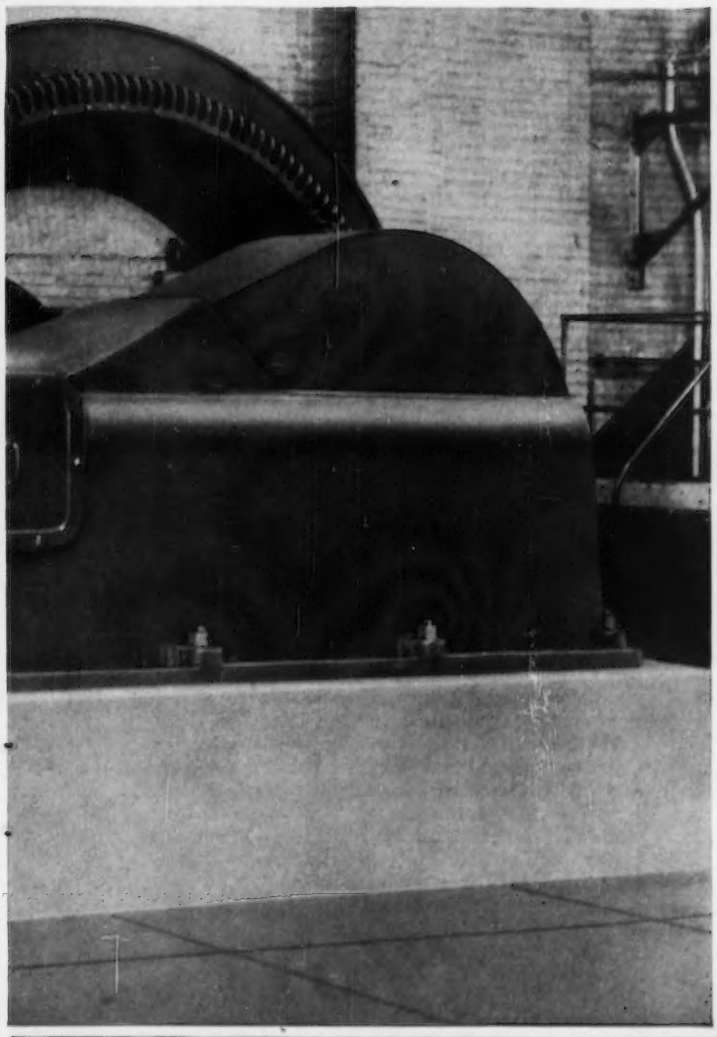

How to keep running at
FOR OVER 25 YEARS, MORE COPPER ORE HAS BEEN MINED IN THE U. S. WITH TEXACO-LUBRICATED EQUIPMENT THAN WITH ANY OTHER

TUNE IN:
METROPOLITAN OPERA
radio broadcasts
every Saturday afternoon

TEXACO

TEXACO

compressors full pressure



What makes one compressor operate more efficiently than another? More often than you think, the answer is lubrication—and the right lubricant must be determined by the size and type of compressor, the operating conditions and pressure. All four factors must be considered.

That is why there is a complete line of *Texaco Regal Oils R & O* to meet all compressor requirements. These oils are made from choice base stocks and are specially refined. Extra processing removes the impurities that form gum, sludge and carbon. Effective additives provide complete protection against rust and oxidation. As a result, compressor valves work smoothly; piston rings stay free and clean.

For your drills, use *Texaco Rock Drill Lubricant EP*. It insures protection against wear, and prevents rust whether the drills are working or lying idle.

A Texaco Lubrication Engineer will gladly help you draw up an economical and effective lubrication program for all your equipment. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

Lubricants and Fuels
FOR THE MINING INDUSTRY

fluidized techniques for SO_2 production in West Germany

The first installation in Germany of a Dorrco FluoSolids system for the production of SO_2 gas from pyrites recently went on stream in a large chemical plant. Main component of the system is the 7-foot diameter Dorrco FluoSolids Reactor in which 36 tons per day of pyrite containing 43% Sulfur is roasted at 900°C, delivering 10,000 CFM of SO_2 gas for the manufacture of 50 tons per day of 98% H_2SO_4.

Today, commercial applications of the Dorrco FluoSolids system for pyrite and pyrrhotites roasting total 52 reactors in 33 installations located in 12 countries. These units cumulatively produce the SO_2 gas necessary for the manufacture of over 5,000 tons per day of sulfuric acid . . . dramatic evidence of the worldwide acceptance of this most significant advance in roasting techniques in the last 35 years.

If there is a step in your flowsheet where intimate contact between solids and gases is essential, fluidization should be investigated. Dorr-Oliver research, design and engineering staffs in collaboration with our associated companies and representatives throughout the world can work to your advantage.

For complete information write Dorr-Oliver Incorporated, Stamford, Connecticut.

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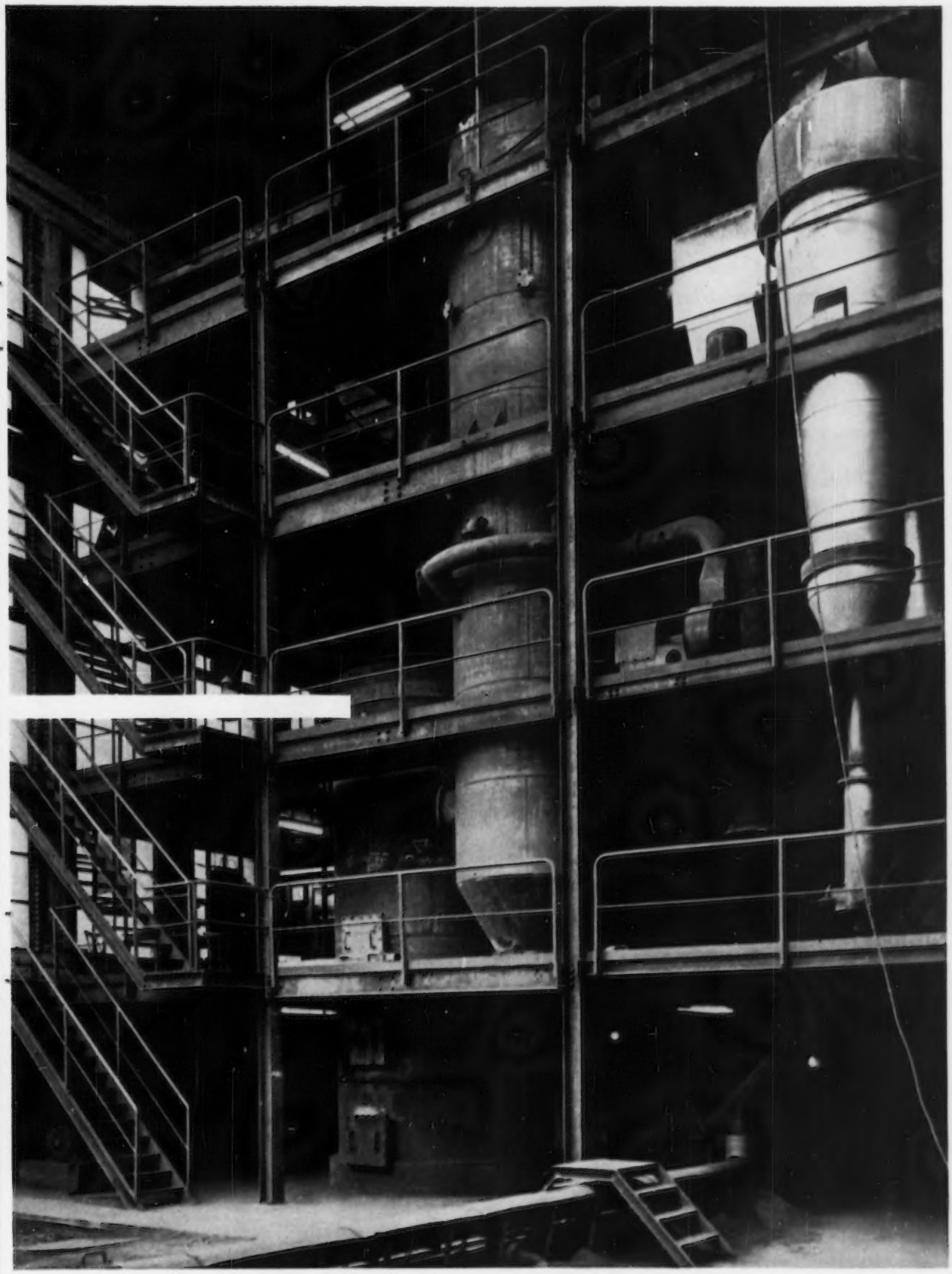


Westinghouse motors and cubic yards of overburden

generator help move 18,000 every 24 hours

New 12-Yard Page Dragline at Marriott-Reed Coal Company, Columbia, Mo., Uses Westinghouse Generator and Two Motors to Swing 360-ton Dragline Every 45 Seconds.

A production jump from 800 to 1,000 tons of coal per day . . . that's the kind of service Marriott-Reed is getting from its new Page Dragline equipped with fast-responding Westinghouse swing motors and generator.

Operating around the clock in all types of weather, one Westinghouse direct-current generator drives two heavy-duty swing motors totaling 312 peak horsepower. By maintaining swing cycle of 12 cubic yards every 45 seconds, 18,000 cubic yards of overburden . . . soapstone, clay and shale . . . are efficiently and profitably removed every 24 hours, with no downtime or work stoppages.

This is just one example of the proven dependability, ruggedness and durability of Westinghouse motors and generators. For more information, call your Westinghouse Sales Engineer. Or write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

J-22071

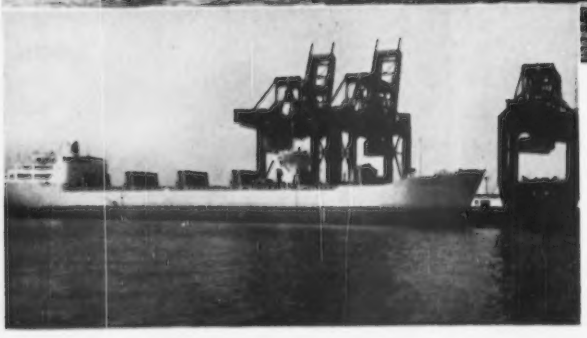
YOU CAN BE SURE...IF IT'S

Westinghouse

This is the special dual-circuit generator which powers the two heavy-duty swing motors on an adjustable voltage system. With this system, the motors can be instantly reversed by reversing the generator fields to maintain the 45-second swing cycle.

Now in operation

Ore carrier docks at C&O's new 1191-foot pier at Newport News with a 19,000-ton cargo.



The three unloaders will empty the vessel between breakfast and supper time and clean out holds without auxiliary equipment aboard ship.

at Newport News, Va.

World's most modern ore unloading facility.

To handle an ever-increasing flow of ore imports by the steel and chemical industries, Chesapeake and Ohio has put into operation the world's most modern and efficient ore unloading facility at its great port of Newport News, Va. Incorporating the best features of American and European designs, the 8½ million dollar installation sets new standards of speed and flexibility for bulk cargo unloaders.

Moving on rails along a finger-type pier designed to accommodate the largest ore carriers afloat, the facility's three unloaders can work vessels on both sides of the pier simultaneously, or as many holds of a single ship. Several sizes of buckets, changeable in less than five minutes, are provided for different types of ore and vessel. Twin belt conveyors and car loading hoppers permit handling two types of ore at the same time without sacrifice of unloading speed. After electronic weighing, accurate to the pound, ore is loaded into thoroughly flushed out open top cars.

With an always ample car supply plus prompt delivery inland by C&O, this facility marks a new high in transportation service for ore importers. Ships now get faster turn-around as well as quick access at C&O's port of Newport News.

A giant bucket drops into the ship's hold to begin unloading at the rate of 18 tons every 45 seconds.

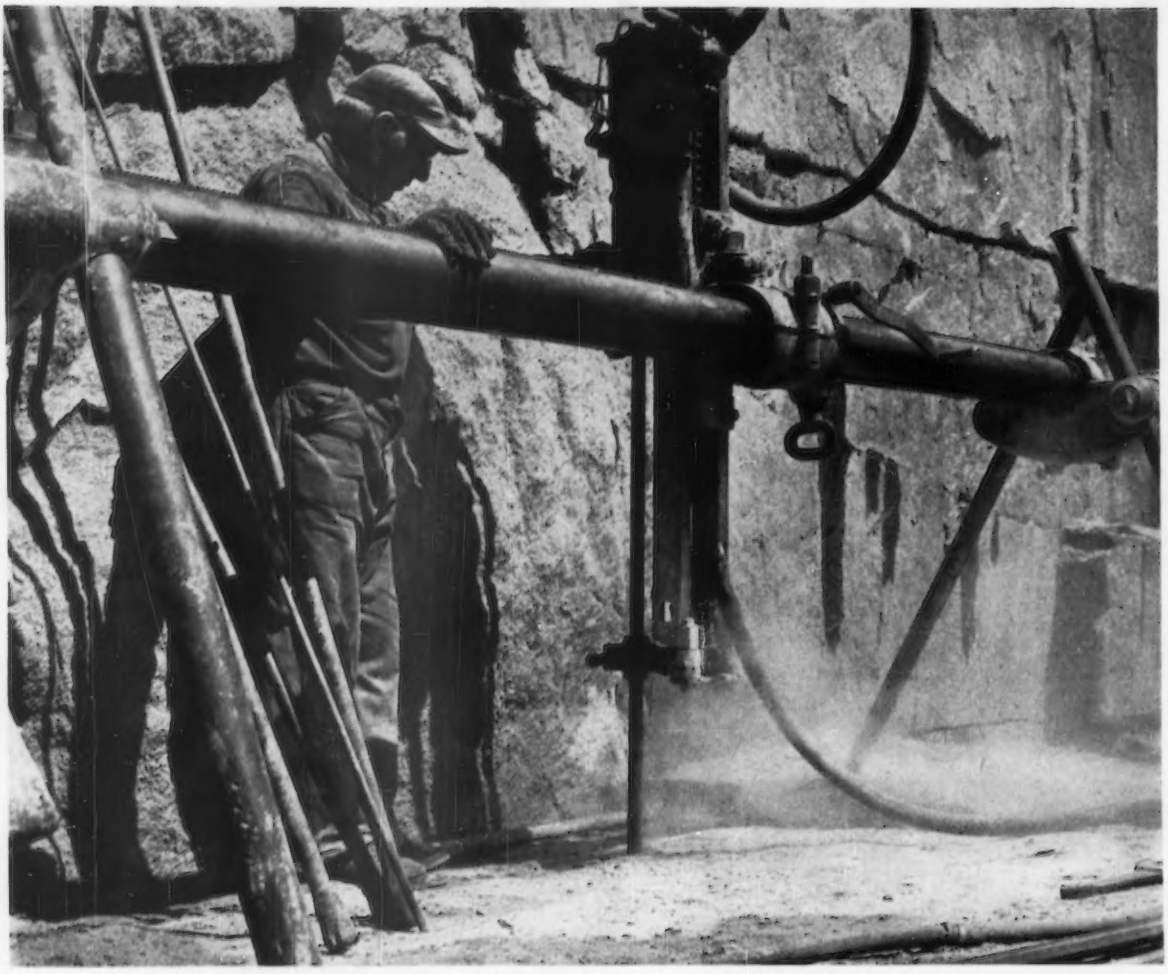
Ore is moved at 600 feet a minute on these conveyor belts to the carloading house.

Write for illustrated folder showing in detail the operation of C&O's new ore unloader.

Chesapeake and Ohio Railway

WORLD COMMERCE DEPARTMENT, NEWPORT NEWS, VA.

World Commerce Dept. Offices: New York 7, N. Y., 233 Broadway • Chicago 4, Ill., 327 S. LaSalle Bldg. Detroit 26, Mich., 525 Lafayette Bldg. • Richmond 10, Va., 823 East Main St. • Stockholm, Sweden, Kungsgatan 7



On an island off Jonesport, Maine, the granite quarry operated by Moose-A-Bec Quarries Co., Inc., uses Bethlehem Hollow in their drills mounted on quarry bars. *Drill steel supplier:* Bicknell Mfg. Co., Rockland, Me.

Quarrying Granite Off Coast of Maine

This picture, showing Bethlehem Hollow Drill Steel biting into granite, was taken at a quarry operated by Moose-A-Bec Quarries Co., Inc., on Hardwood Island, at Jonesport, Me.

At this quarry, which is one of the country's few remaining offshore granite workings, rectangular blocks of medium hard, abrasive stone are cut from a solid mass in single units weighing about 15 tons, for use in the building industry. The drilling is accomplished with jackhammers and drifters equipped with Bethlehem Hollow Drill Steel exclusively, in rounds, hexagons and quarter octagons, and fitted with carbide-insert bits. The quarry management sums up the performance of the drill steel in one word: "Excellent."

Bethlehem Hollow Drill Steel gives a good account of itself in all kinds of rock drilling jobs because it is rolled from fatigue-resistant steel, and has a hole of uniform diameter, centrally located in the bar. Bethlehem Hollow also has a wide quenching range. What's more, it is easy steel to heat-treat for the proper balance of toughness and wear-resistance, making possible long-wearing threads and sturdy shanks.

Bethlehem Hollow is furnished in Carbon and Ultra-Alloy grades in regular lengths of from 18 to 27 ft. Longer lengths can also be furnished. Bethlehem Hollow is hard-working drill steel—good steel to keep in mind for any rock drilling job.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM HOLLOW DRILL STEEL CARBON AND ULTRA-ALLOY

BETHLEHEM STEEL

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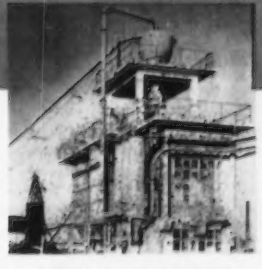
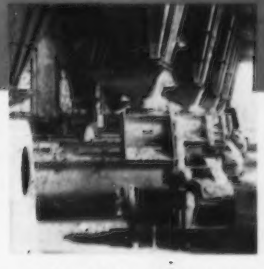


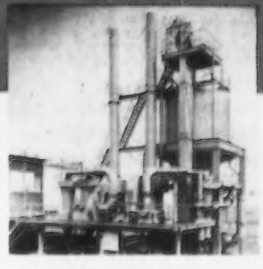
PNEUMATIC CONVEYING

Hartmann has designed, fabricated and installed over 1000 systems for more than 200 different industrial applications. The first, in 1903.



MECHANICAL CONVEYING

In belt, screw, chain, plate and bucket types — experienced in standard and special applications and in combination with pneumatic systems.



DUST REMOVAL SYSTEMS

Fluor-Hartmann designs wet or dry types or combinations of both for critical industrial applications ranging from de-dusting to air sifting.

Sales Offices in:
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Illustration from Agricola's De Re Metallica (1621)

Special attention was necessary

In olden days, every piece of ore presented special problems for the processor. It had to be handled separately . . . . carefully placed under a clumsy stamp . . . and slowly crushed bit by bit.

Today, it is just the opposite. Modern plants produce a never-ending stream of properly sized ore. For they have efficient grinding mills that often use CF&I Grinding Balls and Rods. Always made of special analysis steel that has an ideal balance between toughness and hardness, CF&I Grinding Balls and Rods combine optimum grinding ability with maximum wearability.

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CF&I

5097

At a pit in Germany...

2 Rear-Dumps move 180 tons every hour over 1150 ft. of rough pit floor

At an important German quarry, south of the Ruhr, two Model C Tournapull® Rear-Dumps haul out about 180 tons of blasted limestone rock each working hour.

The German firm, Rheinisch-Westfallische Kalkwerke-Aktiengesellschaft, Dornap, is using these heavy-duty haulers in removing the top layer of a limestone hill at the company's Honnetal quarry. This quarry supplies lime to the chemical and construction industries, and to the steel mills of the Dortmund-Hagen area. Lime dust from this plant is also used in mines to control fires and explosions.

Body design withstands shock loads

A shovel loads the two Tournapulls (one with an earlier 18-ton capacity, the other a current 22-ton model) with large chunks of limestone. The Rear-Dumps' egg-shaped bowl design tends to safely deflect shocks of loading. According to extensive tests in this quarry, trucks with a box-shaped body could be loaded to only 70% of capacity, while Tournapulls were consistently loaded to 85% and 90% of capacity.

During typical operation, Rear-Dumps haul rock about 1150 feet over the rough pit floor. Each unit delivers about 90 tons hourly to a crushing plant, says Graduate Engineer Hettwer, Technical Manager of the quarry.

Tournapulls also haul out waste loam and clay from fissures in the rock. On the waste dump, Tournapulls' big, low-pressure tires and power-transfer differential (which channels more power to the drive wheel on firmer footing) provide ample flotation and traction for hauling across loose fill.

Maneuverability saves time

At times, other types of haul units have been used for transporting rock here. However, they were unable to turn within the narrow space between the pit wall and the shovel's power cable in order to position for loading. Consequently, a bridge had to be laid over the cable for them to drive across. In contrast, Tournapull Rear-Dumps, with their 90° kingpin power-steer, can turn easily in the cable-to-wall space, eliminating the time-robbing practice of having to lay, move, and maintain a plank crossing over the cable.

When you have heavy material to move, or when you must work in a confined space, you will want to know more about Tournapull Rear-Dumps: 11, 22, and 35-ton sizes. Write us for full information on LeTourneau-Westinghouse equipment.

CR-1386-Q-1

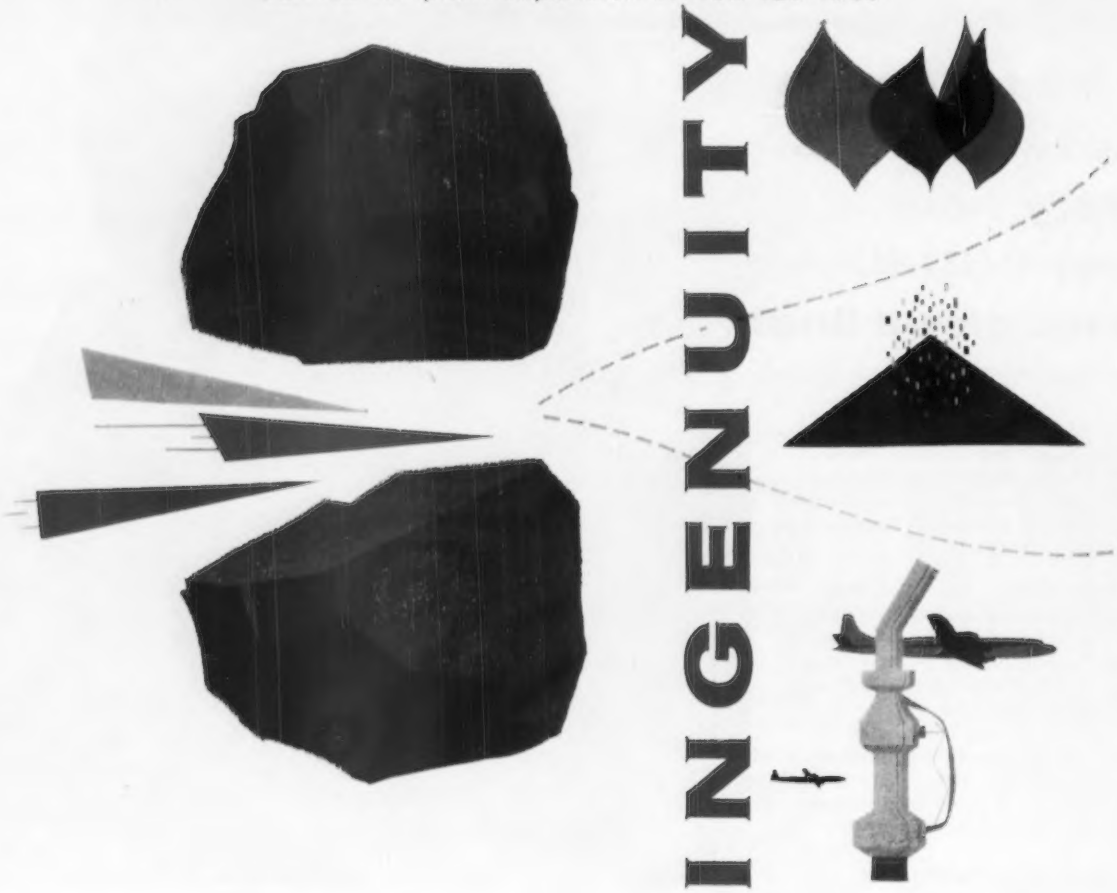
Despite the constant shocks of loading this heavy limestone rock, and of hauling over a rough, rocky surface for 16 hours daily, Tournapull Rear-Dumps have needed little repairs. One Tournapull has worked for more than 2¾ years; a second machine for longer than two years. Most months, Rear-Dumps' operating efficiency is over 90%.

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

call KE for plant expansion or new facilities



has made KE a major engineer-contractor serving Minerals and Petroleum

Nation's pioneer major commercial Gilsonite refinery near Grand Junction, Colorado... Another example of KE ingenuity.

Ingenuity at work—at American Gilsonite, Kaiser Engineers designed and built an enclosed, controlled-atmosphere calciner with associated power and plant equipment making possible 100% utilization of raw Gilsonite. First major all-commercial Gilsonite refinery built, the new plant produces 99.50% pure coke, extreme purity gasoline, and uses gaseous residue to power the entire facility.

From economic analysis through start-up, KE builds ferrous, non-ferrous, industrial minerals and petroleum processing plants; brings valued experience to every phase from mining and beneficiation to transportation and materials handling.

Let KE ingenuity save time and money for you. With your first thought of new facilities or expansion, call KE.

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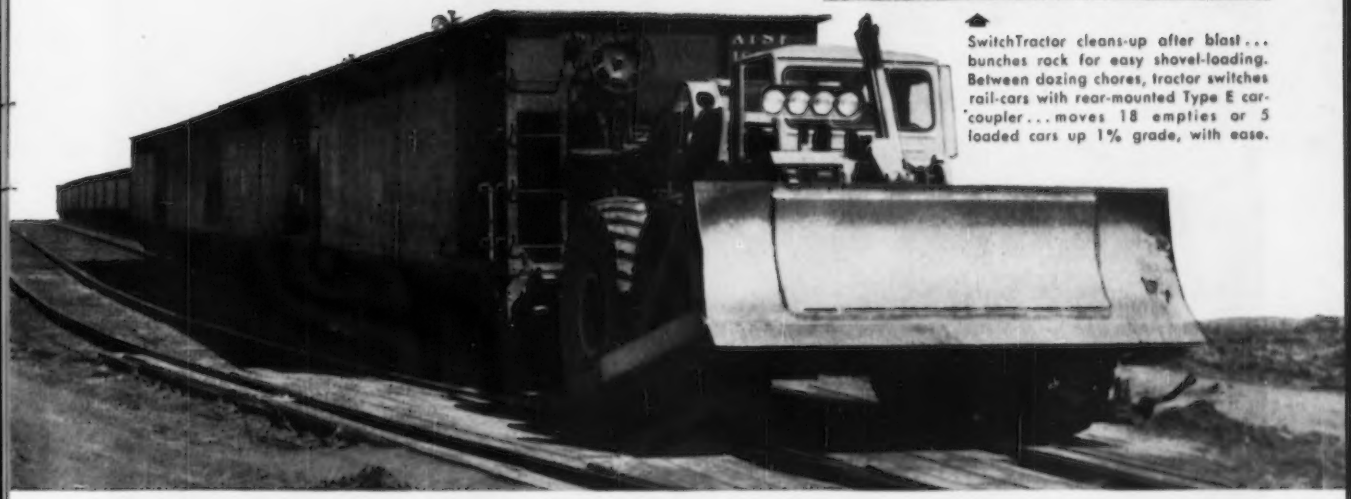
4385

Double-duty pit tractor



SwitchTractor cleans-up after blast... bunches rock for easy shovel-loading. Between dozing chores, tractor switches rail-cars with rear-mounted Type E car-coupler... moves 18 empties or 5 loaded cars up 1% grade, with ease.

SwitchTractor moves rail-cars, dozes, handles clean-up

Here's a big, 210 hp rubber-tired tractor that does double-duty by also switching railroad cars. With its 17 mph speed, and go-anywhere mobility, SwitchTractor works fast ...often switching "for free" in spare time between tractor chores.

Tournatractor with car-coupler

Cost-cutting SwitchTractor is a regular LeTourneau-Westinghouse Tournatractor—fitted for operation of dozer, angledozer, snow plow, and other attachments. In addition, it is equipped with a standard Type E railway coupler attached on the rear. SwitchTractor can either *pull* a string of cars with its coupler... or *push* them with dozer blade; can safely spot or "hump" cars on many widely scattered tracks in a minimum of time.

Switch-engine, not tied to tracks

This 210 hp go-anywhere switcher-dozer is always ready to shift rail-cars wherever needed. Rolling on big rubber tires, it maneuvers quickly from spur to spur... moves back and forth between pit, bench, stockpile, plant, dump, or other location. It travels via roads or cross-country ...always takes the fastest route.

When switching cars, SwitchTractor straddles the rails (6'4" between tires), rolls on tie-ends and ballast. It gets better traction, can *pull twice as many cars* as an on-track switcher of the same weight. Big, low-pressure tires do not damage ties, rails, switches, or pavement.

Saves time on tractor work

Double-duty SwitchTractor also dozes, pulls, and pushes faster than crawlers. Practical work-speeds to 7.5 mph, and top-speed of 17.2 mph, let you handle more plant clean-up and pit maintenance. You build and keep haul roads smoother, open snowed-in roads earlier. You handle shovel clean-up promptly and effectively, spread waste on dumps faster, move utility equipment easier.

On push-and-return work SwitchTractor's constant-mesh transmission with air-actuated clutches, alone, gives you up to 8 minutes extra production per hour. It saves up to 5 seconds, each gear-shift... makes no stops for shifting, loses no momentum... changes direction or gear-ratios *instantly*. In addition, torque-converter (standard equipment) provides uniform and most effective engine speed — with automatic rationing of wheel speed to load — for maximum efficiency in application of power.

Go-anywhere mobility widens work-range

Because 17 mph SwitchTractor *travels job-to-job twice as fast* as crawlers, it works more productive hours per day... services more pit operations, gets to work faster, handles more work over a wider range of travel. It requires no special planking for moves... no flatbed-hauler, trucks, and extra help.

This rubber-tired L-W SwitchTractor is a two-way money-saver for mine, quarry, or pit. Call or write for complete details and prices.

SwitchTractor—Trademark; Tournatractor—Trademark Reg. U.S. Pat. Off. ST-1355-M-b

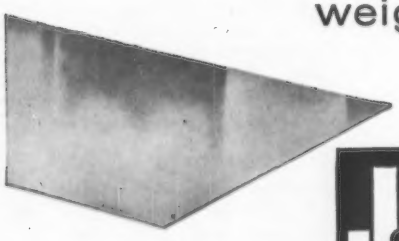
LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

JALTEN low alloy high-strength J & L steel

provides equal strength with lighter weight



Jalten permits high design loads with reduction in section. Usual reduction is two gages with weight saving as much as 25%.

High strength of Jalten is the result of balanced chemical composition which is carefully controlled during production. Jalten's strength is retained through fabrication and welding without further heat treatment.

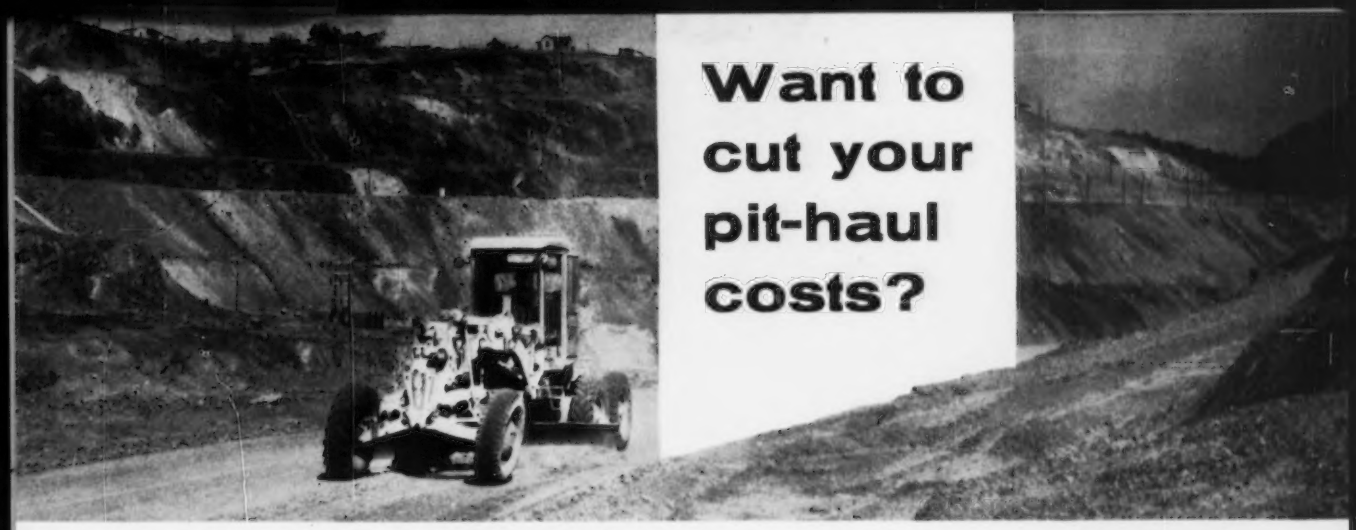
Jalten is available in the forms you require (plates, hot rolled sheets, hot rolled bars, small shapes and structurals). Jalten can be purchased in three grades to meet specific requirements for high strength, formability, impact, resistance to corrosion.

Your local distributor can supply you with information on Jalten, or you can write direct to the Jones & Laughlin Steel Corporation, Dept. 412, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

J&L STEEL

Jones & Laughlin

... a great name in steel



Want to cut your pit-haul costs?

How 15-speed "blade" can help your haulers make extra pit-to-plant trips every day

You'll reduce the per-ton cost of hauling, boost pit output every day, by traveling your haulers at higher speed. Faster haul speeds are practical *only* when your pit floor, benches, and haul roads are kept clean, smooth, and well drained. The better your surface, the faster you haul... the more trips per day, the lower your pit-haul costs.

To keep your haul routes in tip-top shape you need graders that can do maximum work. You need machines that can make heavier cuts, push bigger loads, work and travel faster ... machines that can always work your tough materials at, or near, full power. This requires a wider range, and more selective gear-ratios than most graders afford.

More speeds for full-power work

Only Adams* 80 to 150 hp graders give you the extra work-speeds you need. They provide 8 standard speeds forward and 4 reverse, plus 3 creeper gears (opt.)... that's 15 speeds in constant-mesh transmission.

For building and maintaining haul roads, ditching, and clean-up at pit, plant, and stockpile, Adams gives you 4 efficient forward working speeds. Other graders with 6 forward speeds have only 3 working gears... often cannot develop full push-power at the faster speeds that are "just right" for the job.

Adams' 2 intermediate gears, 10 and 14 mph, are handy for light, fast blading, snow plowing, maneuvering and climbing tough grades. And travel speeds to 26 mph save time between grading assignments... time that can be used for extra blade-work.

Up to 30% more push-cycles on one-way grading

Most graders have only 2 reverse gears... about 3 and 7 mph. Adams has 4 reverse speeds — 2 for working, 2 for high-speed back-up. Adams' top reverse speeds (8 and 13 mph) pay big dividends. Often your operator works a 200′ to 400′ stretch, or even more, that is too short or too confined to make turning-around worthwhile. Instead, he backs-up. The Adams makes the reverse trip fast... converts usually wasted travel-time to extra blade-work.

Creeper gears for added "muscle", precise control of grade

Three optional creeper speeds, 31′ to 160′ per min. (full power, 0.41 to 1.82 mph), afford a means to concentrate full engine-power for ripping-up and regrading old roadways, pioneering for exploration and new roads, clearing overburden of stumps and roots and working thru rocky ground. They eliminate the costly common practice of "slipping the clutch" at high rpm to get maximum power at slow speed... reduce shock and clutch wear. Creepers also help you cut more accurate grades, and work in tight places.

190 hp POWER-*Flow** 660

For maximum push-power *at all speeds*, Adams POWER-*Flow* Model 660 with torque converter gives you the effective work-power of an *infinite* number of gear ratios, from 0.0 mph to 27.4 mph forward.

Any one of the 6 Adams grader models — 190, 150, 123, 115, 85, 60 hp — will handle more work per $ investment. There is a size to fit your grading problems in any type of pit-plant situation. In any size, Adams will keep your haul routes smoother than can similar competitive machines. Call us for details.

Adams graders can handle more of your type of jobs, save time and money with efficient interchangeable attachments. These include: *Scarifier* for ripping-up old roadways and rock-filled soil, *bulldozer* for spreading and casting dirt and road materials, *snow equipment* for clearing roads, *push-plate* for push-loading scrapers and starting balky haulers.

*Trademark G-1626-MQ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

IT'S CHRISTMAS

KENNEDY-VAN SAUN

At this season of the year
we pause to thank our
many loyal friends whose
confidence in our equipment
has made our continual
growth possible.

around the world...

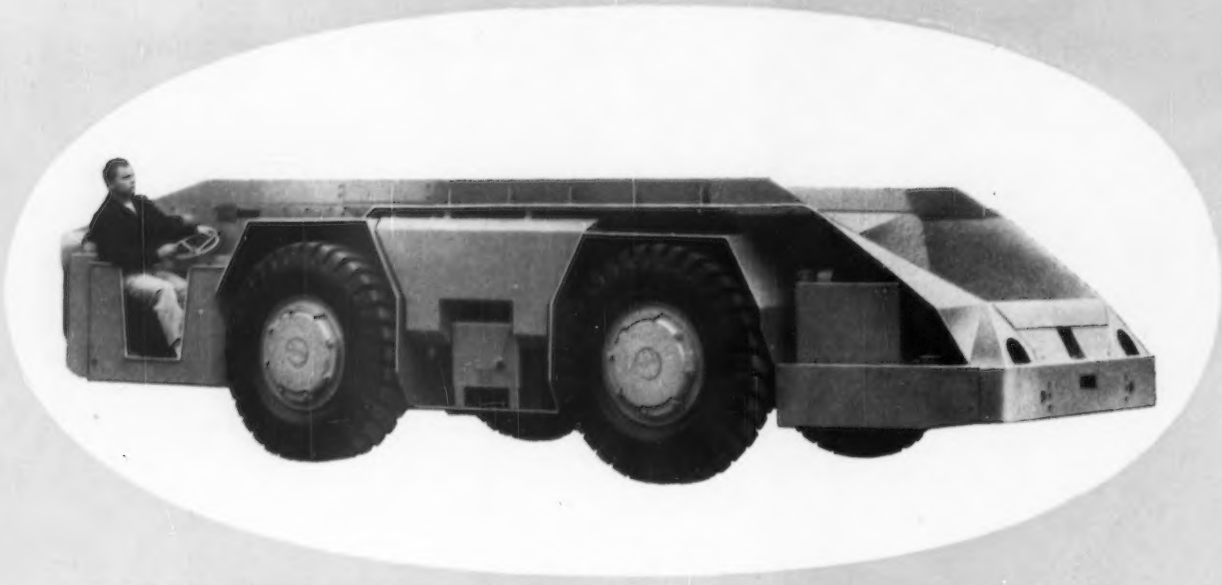
GREETINGS
And Best Wishes
For A
Prosperous New Year

J. E. Kennedy
CHAIRMAN OF THE BOARD

MANUFACTURING
& ENGINEERING
CORPORATION

TWO PARK AVENUE, NEW YORK 16, N. Y.
FACTORY, DANVILLE, PA.

Your Key To Better



THE NEW National Mine

National Mine Service Company

The simplicity and effectiveness of the single prime mover principle for shuttle cars is again proving itself in the new National Mine Diesel TorKars—just as it has in the A.C. and D.C. models of this advanced design of car.

Initially developed and built by one of the nation's largest mining companies, with years of experience, the TorKar was constructed to eliminate the weaknesses found in conventional shuttle cars. The new car so far exceeded expectations in five years of exhaustive testing and actual operation that it was decided to make it available to the mining industry through selection of National Mine as the exclusive manufacturer and distributor.

With excellent facilities and technical assistance, National Mine has further developed the TorKar and produced several different models based on the principle of a single prime mover driving through a torque converter. Now, for the first time, diesel TorKars have been introduced; and already they are establishing new standards for performance and maintenance.

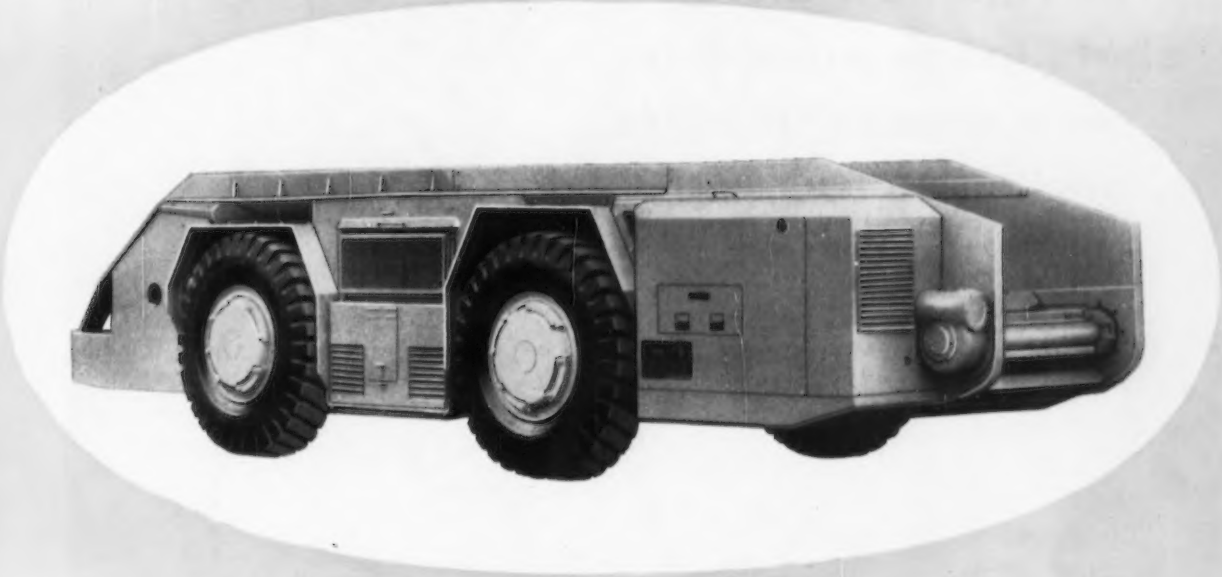
The single-stage torque converter cushions and reduces peak loads and shock, protecting both the engine and transmission from excessive wear and reducing maintenance. The three-speed transmission permits the operator to select a gear suitable for the type of grade and roadway. Consequently, engine power is more fully employed and there is no need for overpowering, with all the attendant factors which increase cost of operation and maintenance—and may even affect ventilation.

Among the many plus features of the diesel TorKar are a patented National Mine exhaust gas conditioner which has been used very successfully on various types of diesel-powered underground mining machinery; convenient controls; four-wheel drive and steering; new type interchangeable, heavy-duty spur gear-and-pinion wheel units; abrasive-resistant liners in the hopper and conveyor bed; solid flights; and rugged frame and body.

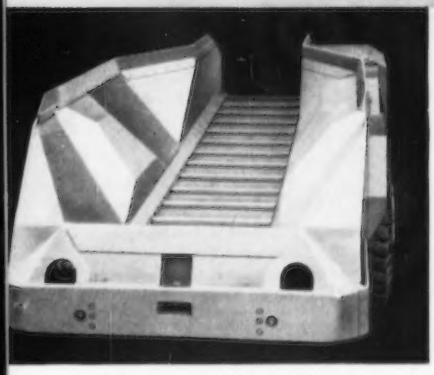
The design of the diesel TorKar gives it great flexibility, and models are available with tractive characteristics and overall dimensions suitable for almost any mine operating conditions. For full details on these remarkably efficient new diesel shuttle cars, write, or consult your National Mine representative.

*trademark

Mine Haulage...



DIESEL TORKAR*



60" car has 253 cubic feet capacity—sideboards can be added. *(below)* Controls are conveniently grouped. Clutch lock has "deadman" control.

Specifications

Capacity: 15 to 18 ton

Length: 24'6"

Width: 111½" overall; body 96"

Wheelbase: 102"

Height: 60" without sideboards

Weight: 34,000 lbs.

Tires: 14.00 x 24, 20 ply

Engine: Optional

Fuel Tank: 60 gal. capacity

Speed: Loaded car on level—low 2.2 mph; second 3.6 mph; high 5.2 mph.

Transmission: Constant mesh, three speeds forward and reverse

Drive: Torque converter

Steering: Hydraulic power

Exhaust: Patented National Mine exhaust gas conditioner

National Mine Service Company

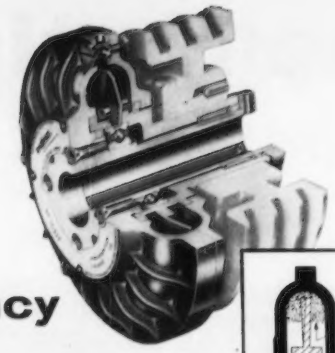
564 Alcoa Building • Pittsburgh, Pennsylvania

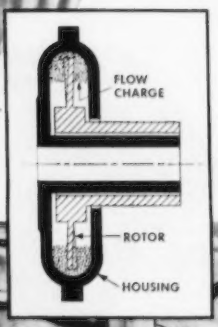
Canada: Mine Equipment Company Limited, Montreal, Quebec

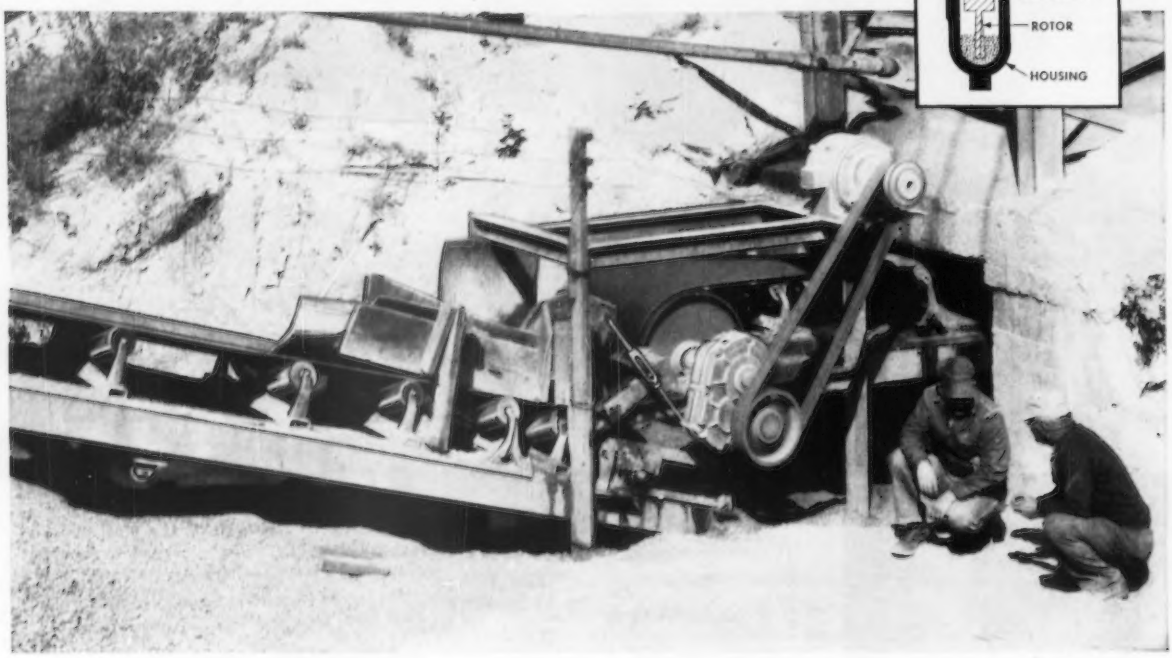
South Africa: Dowson & Dobson Ltd., Johannesburg

Australia: Noyes Bros. Pty. Limited, Sydney

This new drive starts loads smoothly... with smaller motors ...and gives 100% efficiency at full load!







FLEXIDYNE

THE DRY FLUID DRIVE

This tunnel conveyor, 225 feet long, handles 500 tons of sand and gravel per hour—8 to 16 hours a day.

With Flexidyne, the motor picks up the load easily and smoothly. Power investment is reduced, power costs cut, maintenance simplified and conveyor belts are protected against breakage.

Flexidyne, the Dry Fluid Drive, is the *new* development that starts loads smoothly, that protects against shocks and overloads, that saves power and that gives 100% efficiency at full load!

The "dry fluid" in Flexidyne is heat treated steel shot. A measured amount, called the flow charge, is contained in the housing, which is keyed to the motor shaft. When the motor is started, centrifugal force throws the flow charge to the perimeter of the housing, wedging it between the housing and the rotor which transmits power to the load.

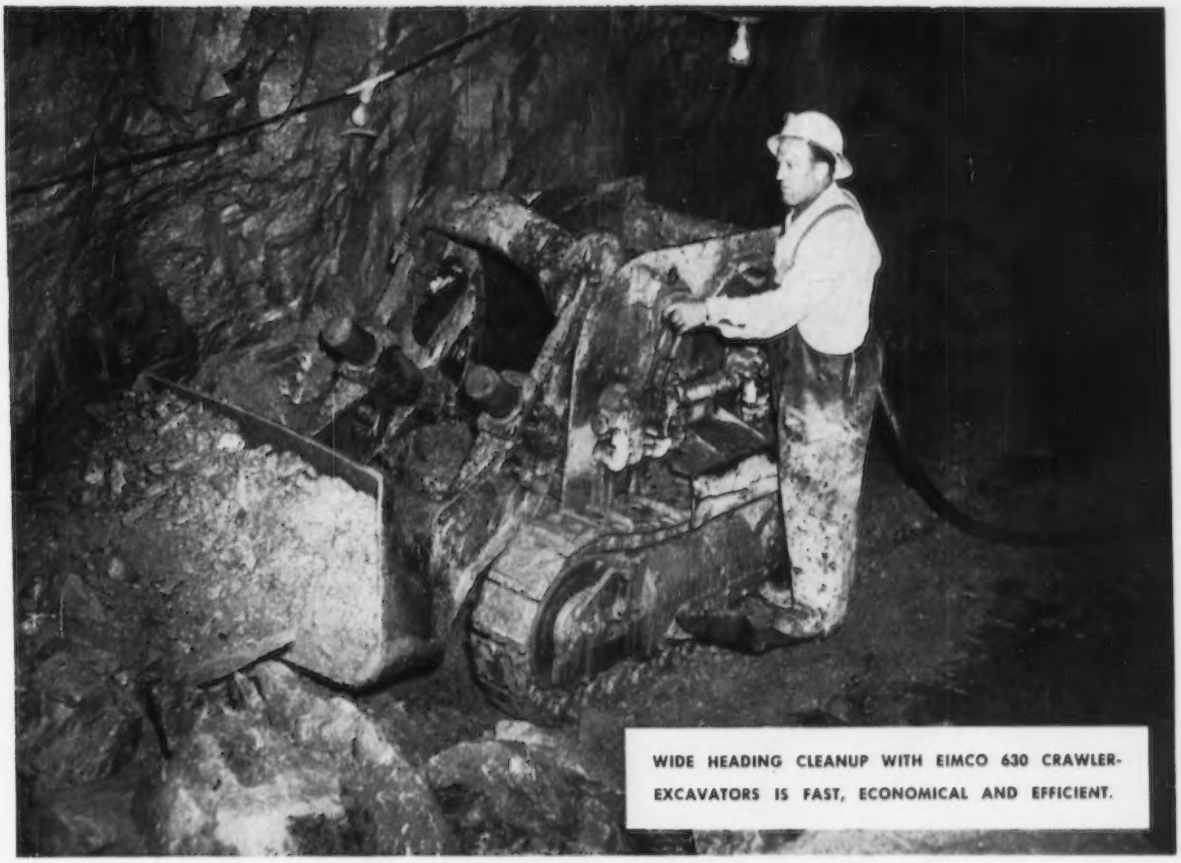
After a momentary slip between housing and rotor, the two become locked together and achieve full load speed without slip and at 100% efficiency during the running cycle. Changes in weather—hot or cold—inside or out—do not affect operation of Flexidyne.

Flexidyne is now available in 8 sizes—for use with electric motors and internal combustion engines from 1 hp to 300 hp. While each size is power rated, the flow charge can be varied at will to give tailor-made torque for your particular job. Write for Bulletin A-640.

DODGE MANUFACTURING CORPORATION
3100 Union Street, Mishawaka, Indiana

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in in your classified phone book, or write us.

DODGE
of Mishawaka, Ind.



WIDE HEADING CLEANUP WITH EIMCO 630 CRAWLER-EXCAVATORS IS FAST, ECONOMICAL AND EFFICIENT.

REDUCE THE COST SQUEEZE WITH EIMCO 630 TRACTOR - EXCAVATORS

With the "cost squeeze" tightening . . . you can use production savings offered by the Eimco 630 Tractor-Excavator to profitable advantage.

The 630 provides you features that pay-off in more production, operator efficiency and safety. Ruggedly constructed to withstand the severest operating conditions, the 630 insures against excessive down-time and costly maintenance.

Easy, convenient controls make the Eimco respond instantly to the operator's demands. In tough digging (with independent track reversal) he can maneuver the Eimco fast and sharp — from side to side — to cram the bucket without making a new approach. He can move the loaded bucket into overhead dump position while traveling.

Bulletin L-1039 will acquaint you with more Eimco 630 details. An Eimco Engineer will provide you with reliable production information.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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Cleveland, Ohio Houston, Tex. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-287

The world of science behind
EXIDE-IRONCLAD BATTERIES

Being interviewed is W. W. Smith, Divisional Manager, Product Engineering. Grids in back are of Exide's exclusive Silvium. Those in front are ordinary alloys.

"All of these alloys had the same acid test"

At the Exide Laboratories—**Reporter:** Was it a typical charge-discharge test normally used to test battery components?

Smith: Right. And the two positive plate grids with no visible signs of corrosion are Exide's patented Silvium alloy.

Reporter: How about the others—what alloys are they?

Smith: They're standard alloys used in other well-known makes of batteries. But they don't have Silvium's corrosion-resisting ingredients.

Reporter: Where is Silvium used?

Smith: In the positive plates of all Exide-Ironclad and many other Exide Batteries.

Reporter: How does it affect battery performance?

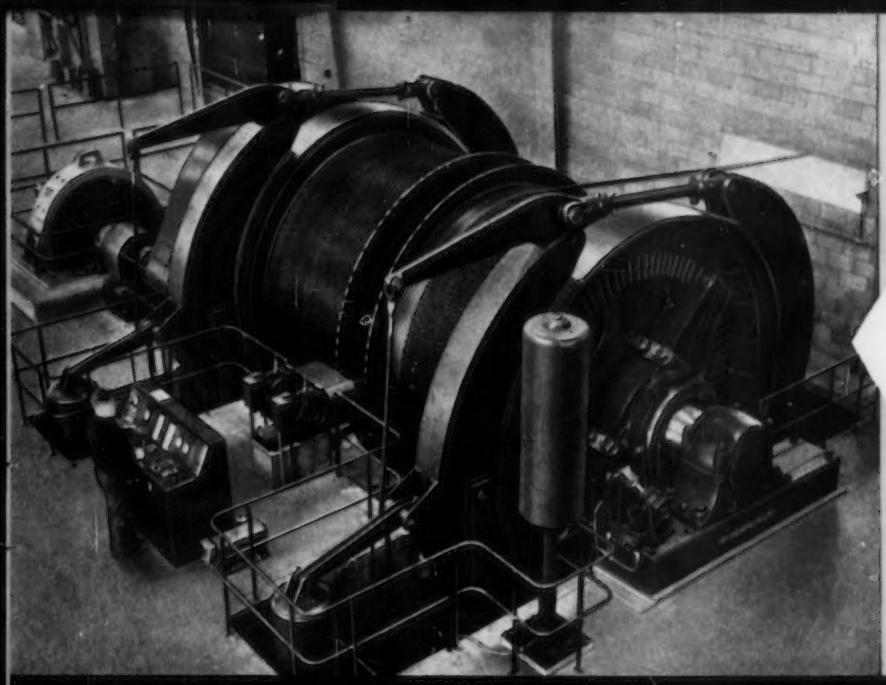
Smith: Every test we've made proves it stretches battery life because the grid resists corrosion—sometimes up to 100% longer.

Reporter: Obviously this is an important feature of the Exide-Ironclad.

Smith: Yes it is, but it's just one of many engineering details that contribute to its high capacity and long life.

Note to battery users: Whenever you order heavy duty batteries or the equipment that requires them, be sure to specify Exide-Ironclad. For detailed bulletin, write Exide Industrial Division, The Electric Storage Battery Co., Philadelphia 2, Pa.

THE ELECTRIC STORAGE BATTERY COMPANY **Exide**®



CONVENTIONAL DRUM HOISTS

Typical of the large hoisting machinery built by Nordberg is this conventional 12′ diameter by 84″ face double drum ore hoist which serves a prominent iron producer. This hoist is designed for a depth of 2800 feet, using 10-ton skips and hoisting 14 long tons of ore at a rope speed of 2000 feet per minute.

Nordberg hoists are available for manual, push-button semi-automatic, or fully automatic control.

NORDBERG'S 61 YEARS of MINE HOIST EXPERIENCE can help you select the best hoist to meet your requirements

▶ Why not let over half a century of specialized mine hoist experience help you select the *right* type and size hoist to meet your specific operational requirements?

With the trend toward larger tonnages and more powerful hoists, greater emphasis must be placed on the proven experience and ability of the hoist manufacturer. Here, Nordberg has an established reputation second to none, and can furnish both conventional and friction type hoists. This wide experience is at the call of mine executives everywhere. *Consult Nordberg on your next hoist problem.*

FRICTION TYPE HOISTS

Where applicable, the hoisting of ore, men or materials can be economically handled with Nordberg Friction Hoists . . . built for either counterweighted skip or skips-in-balance operation. Manual, push-button semi-automatic, or fully automatic control available. Outstanding features of the Nordberg design include: One-piece welded steel drum; anti-friction roller bearings throughout; pressure applied—pressure released hydraulic brakes with emergency gravity application.

Illustrated is a 4-rope hoist designed for push-button semi-automatic, multi-level operation, to handle men and material.

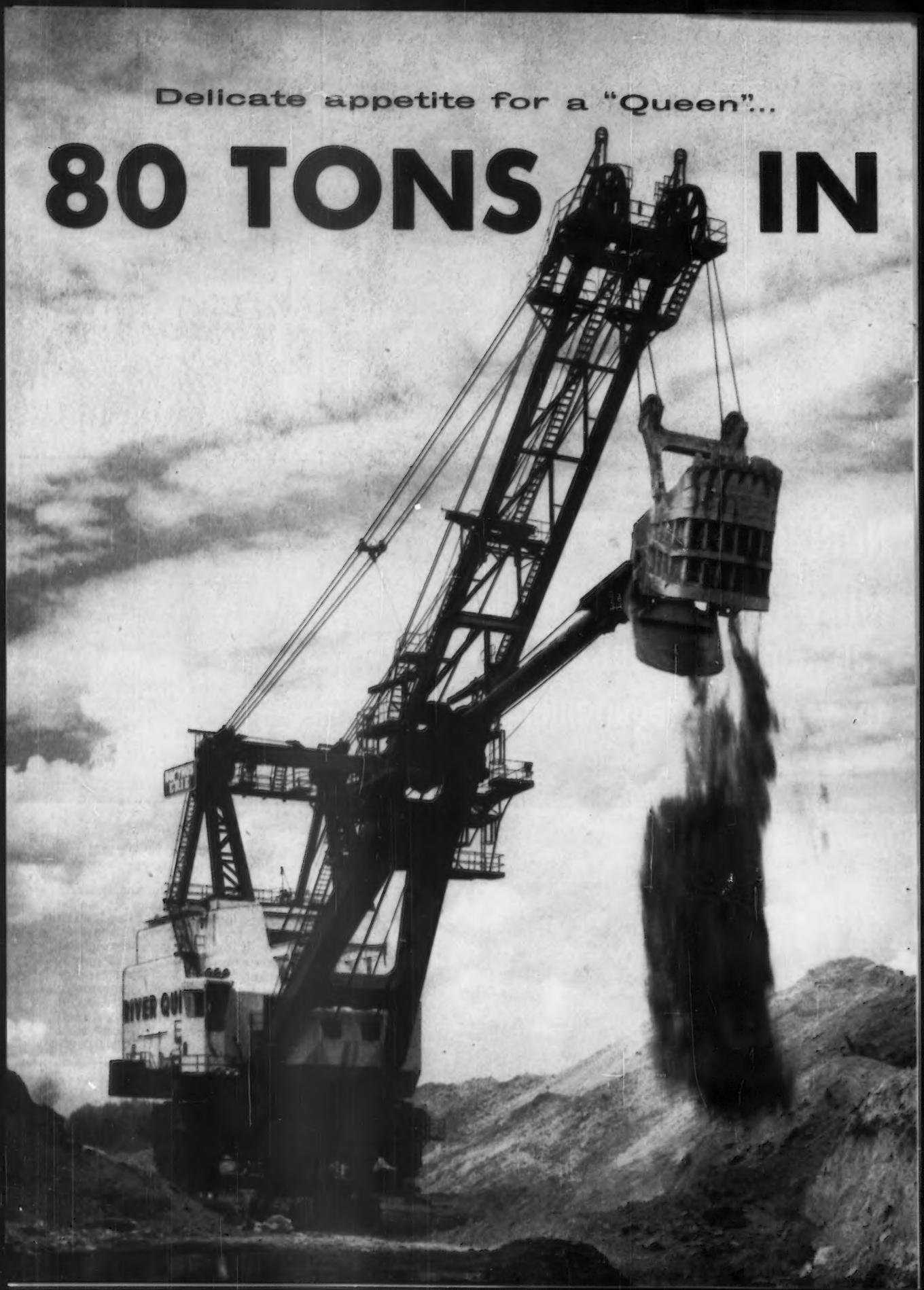
NORDBERG
MINE HOISTS

NORDBERG MFG. CO.
Milwaukee 1, Wis.

© 1957, Nordberg Mfg. Co. MH157

Delicate appetite for a "Queen"...

80 TONS IN



ONE BITE!

BUT LOOK AT THE SIZE OF HER! Taller than a 13-story building, and weighing 2,400 tons, this lady is entitled to a queen-size appetite. She's the *River Queen* — largest power shovel ever built by the Bucyrus-Erie Company. And her big 80-ton bucket is made of tough USS "T-1" Steel to keep her eating regularly for a long time.

Backed by 11 powerful motors and fronted by a formidable row of ripping teeth, the Queen's huge maw scoops up 55 cu. yds. of overburden at a gulp and dumps it nearly 300 feet away from the digging point. Digging and dumping in less than a minute, the *River Queen* could pile up a mountain of more than 100,000 tons of overburden in 24 hours!

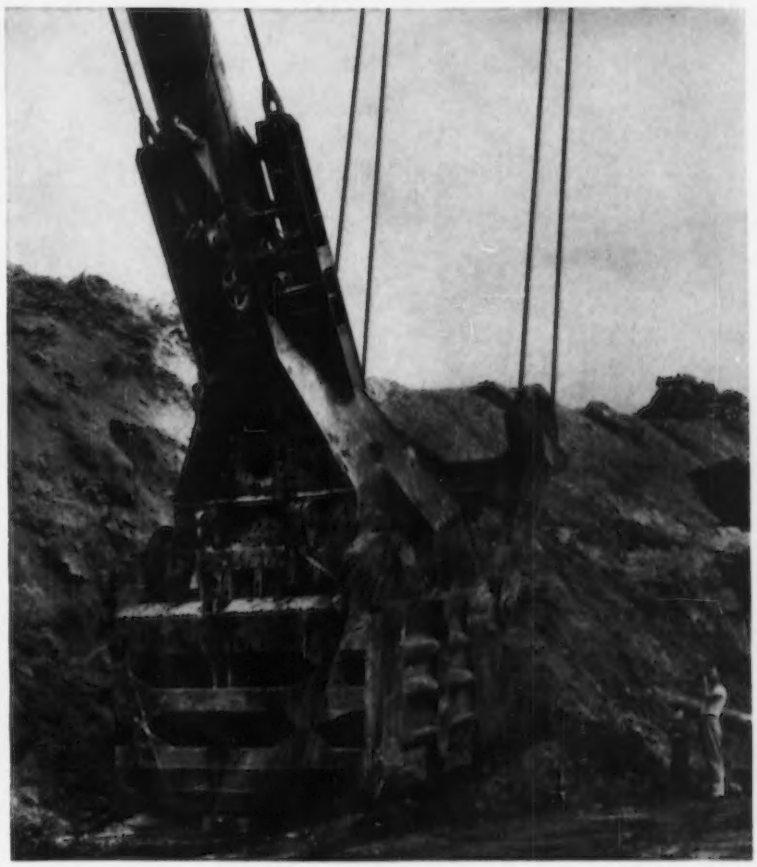
The big shovel is being used to uncover two seams of coal for W. G. Duncan & Peabody Coal Companies in western Kentucky. When the mine is in full operation, its output is expected to be 2 million tons of coal annually. The "Queen" will be highly instrumental in making this possible.

With all the weight and mechanical muscle the big shovel possesses, her bucket has to be a real battering ram. That's why it's made of USS "T-1" constructional alloy steel. Biting and ramming through rock and earth, hour after hour, day after day, is punishing service. USS "T-1" Steel is designed to take this kind of impact, shock and abrasion. And its amazing toughness never falters, even at temperatures far below zero.

You Need USS "T-1" Steel

When you want strength far beyond the ordinary. USS "T-1" Steel has nearly three times the yield strength of structural carbon steel. This is far higher yield strength than has ever before been available in weldable plate steel. What's more, its strength is not lowered by welding or gas-cutting.

For equipment subject to impact abrasion. USS "T-1" Steel can be obtained quenched and tempered to a minimum hardness of 321 Brinell. Even this very hard grade can be welded and flame-cut *right in the field* without preheating. Thus, you don't have to shut down costly, big-capacity equipment for the many hours generally required for shop repairs.



The very high yield strength of USS "T-1" Steel—90,000 psi—saved tons of weight in the big bucket, making a bigger pay load possible with each scoop. Speaking of strength, the 86-foot dipper handle and 145-foot boom are made of another U. S. Steel product, USS TRI-TEN high strength steel.

If your equipment must withstand severe impact abuse. USS "T-1" Steel insures against damage in winter weather. Whether furnished to 321 minimum Brinell or to 90,000 psi minimum yield strength, it has exceptional toughness and resistance to brittle failure, even at temperatures far below zero.

• • •

USS "T-1" Steel can save you money. Send for our new catalog for the full story. Write to United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

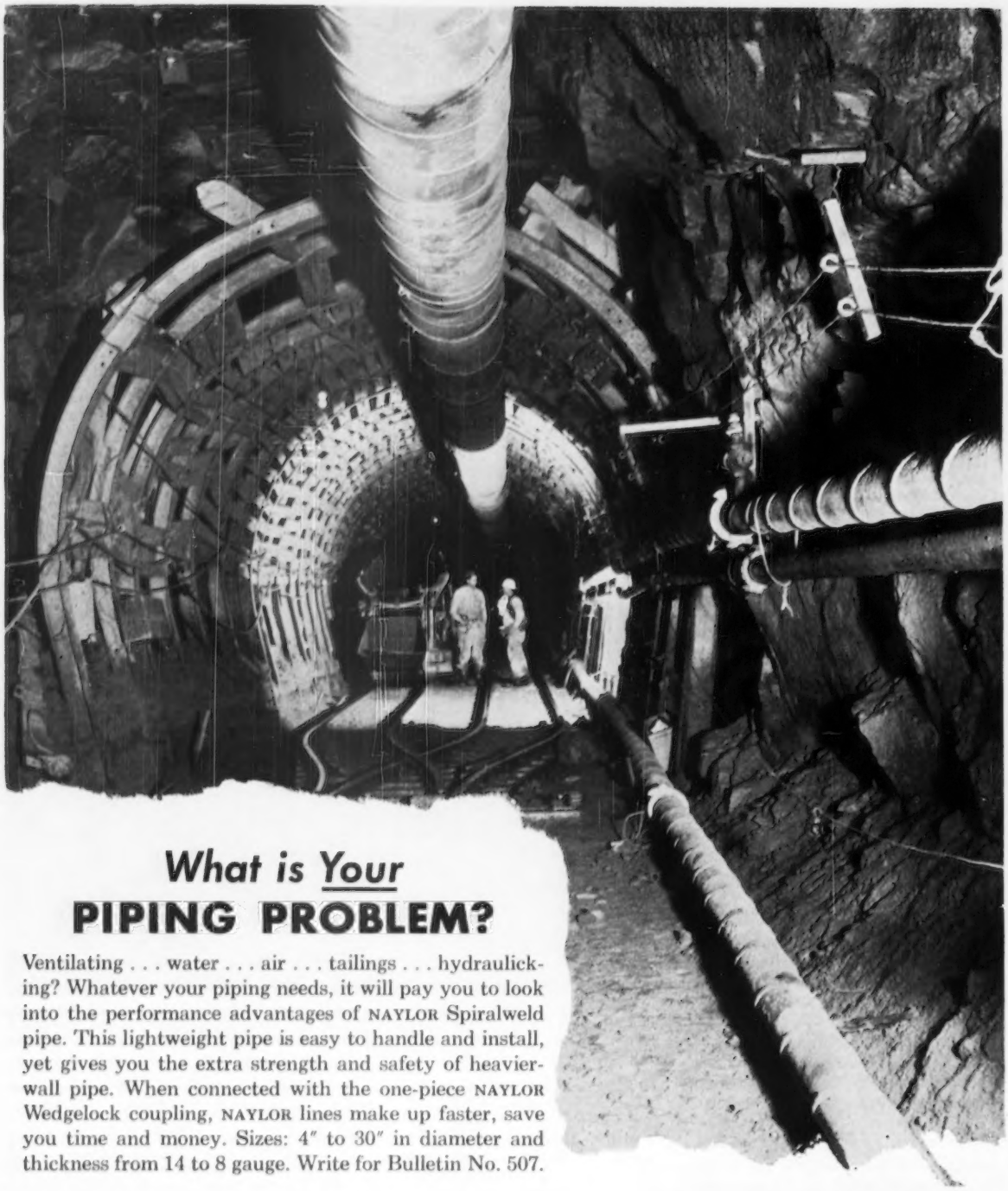
Also available from United States Steel—USS COR-TEN, USS TRI-TEN, and USS MAN-TEN steels—for many years standards for mining and ore handling equipment.

United States Steel Corporation, Pittsburgh · Columbia-Geneva Steel Division, San Francisco
Tennessee Coal & Iron Division, Fairfield, Ala.
United States Steel Supply Division, Warehouse Distributors, Coast-to-Coast
United States Steel Export Company, New York

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

"USS," "T-1," Cor-Ten, Man-Ten and Tri-Ten are registered trademarks

UNITED STATES STEEL



What is Your
PIPING PROBLEM?

Ventilating . . . water . . . air . . . tailings . . . hydraulicking? Whatever your piping needs, it will pay you to look into the performance advantages of NAYLOR Spiralweld pipe. This lightweight pipe is easy to handle and install, yet gives you the extra strength and safety of heavier-wall pipe. When connected with the one-piece NAYLOR Wedgelock coupling, NAYLOR lines make up faster, save you time and money. Sizes: 4″ to 30″ in diameter and thickness from 14 to 8 gauge. Write for Bulletin No. 507.

NAYLOR

NAYLOR PIPE COMPANY
1243 East 92nd Street, Chicago 19, Illinois

Eastern U.S. and Foreign Sales Office:
60 East 42nd Street, New York 17, New York

In Utah . . . and the World Over
BUCYRUS-ERIE ELECTRIC SHOVELS HELP KEEP HAULING UNITS ON THE GO!

This Bucyrus-Erie 110-B with 4½-cu. yd. dipper is loading out waste rock at a vast copper mining project in Utah.

Dependability is a big reason why Bucyrus-Erie electric shovels keep haul units on the go the world over. The heavy-duty construction of these shovels lets them take over the tough work . . . and keep working day after day, year after year. The exclusive two-section boom, tubular dipper handle and twin dual hoist combine to provide great strength, while reducing power-consuming deadweight. Strain on swing machinery is reduced . . . work cycles speeded.

And Bucyrus-Erie electric shovels are as productive as they are dependable. With the tubular dipper handle free to turn in the saddle block when digging strains fall heavier on one side of the dipper than the other, torsional strains in the handle itself are eliminated. The twin dual hoist ropes pull the dipper straight through the toughest banks. Let us tell you more about the proven dependability and big output of Bucyrus-Erie electric shovels. Write for full information.

143157C

BUCYRUS-ERIE COMPANY

South Milwaukee, Wisconsin

MAX-WEAR ALLOY

makes parts like these last longer

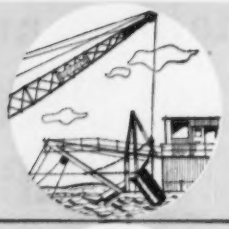
DREDGE BUCKET

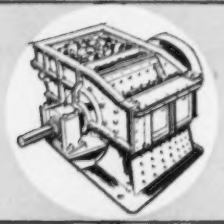
ROCK CRUSHER

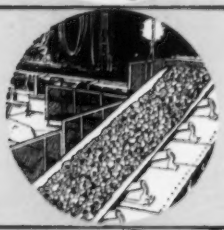
CHUTE LINING

WEAR PLATE

GROUSER BARS







—keeps equipment on the job

Max-Wear Alloy Steel (13% manganese, 2% nickel) is *work hardening!* This means the more it's used the harder the surface becomes (up to 500/550 BHN). But only the surface hardens; the interior of the steel is unaffected. As a result, Max-Wear parts have truly wear-resistant surfaces *plus* high strength and toughness internally.

When you make parts like those shown with Crucible Max-Wear, you reduce downtime, cut repair and replacement costs. For Max-Wear resists repeated heavy impacts and abrasion—just what you need on jobs where equipment takes a bad beating.

Crucible Max-Wear is especially practical for repairs in the field. It can be formed cold or at *red heat,* and is easily shear or torch cut and welded. No annealing is necessary after these operations—a big advantage in the field.

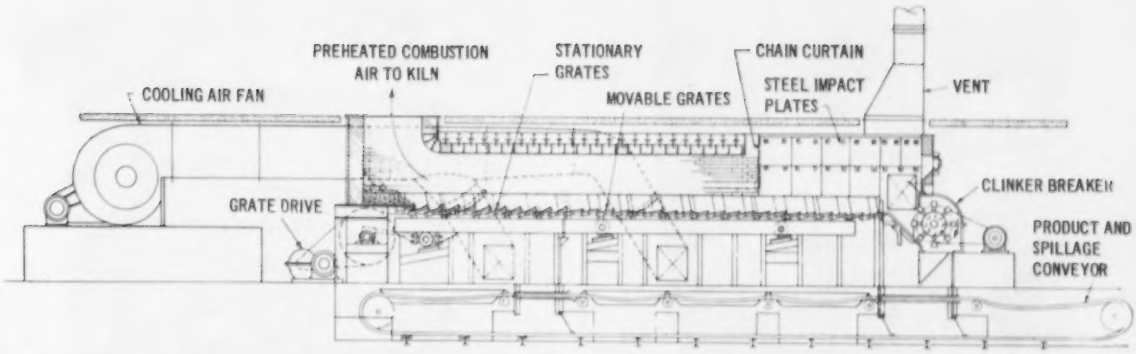
Max-Wear is now available in rounds, squares, plates and special grouser shapes. If you are looking for an easy-to-use alloy steel that will give you longer service under impact, wear and abrasion, try Crucible Max-Wear. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

E&MJ NEW PRODUCTS DIGEST

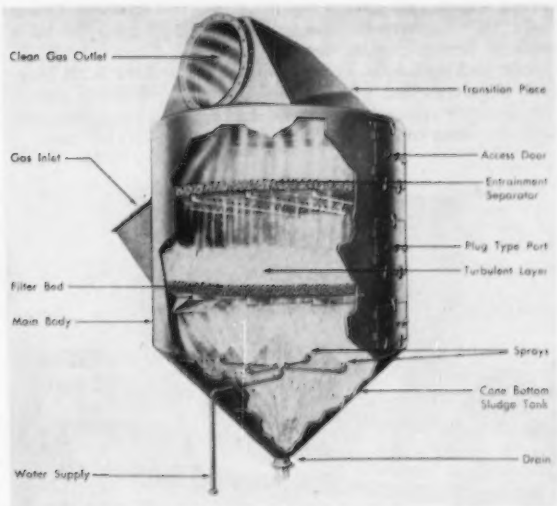
James W. Franklin



Horizontal-Grate Cooler Offers Greater Cooling Efficiency, Saves Space (1)

Designed to cool material discharged from rotary kilns, sintering machines roasters and various other furnaces, this grate cooler can be used for materials ranging in size from fine sand to pellets and clinker. On the horizontal design, material is pushed by the moving grates over the stationary ones.

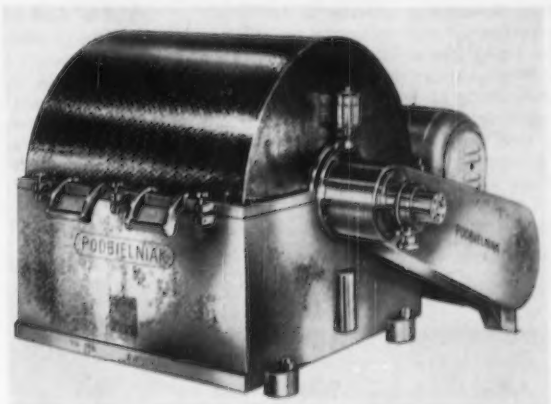
Material spreads across the width of the cooling plane thereby permitting use of a wider, yet shorter, cooler. Cooling air is forced up through the horizontal spaces between the grates and through the vertical openings in each grate. Rate of grate travel can be automatically controlled by the weight on each grate to keep uniform bed thickness. Product of the Fuller Co.



Wet Scrubber Has Low Water Consumption (2)

National Dust Collector Corp. has added a new wet scrubber to their line of dust collectors. Type IC Hydro-Filter has these advantages: common settling tank or basin for more than one filter collector, single sludge removing conveyor serves several collectors, longer settling time due to a larger settling area, lower water consumption. Also, it can be elevated above the floor level on the installation.

For more details on these items, use card opposite p 42.



World's Largest Centrifuge Takes 90,000 gph (3)

Displayed at the 26th Exposition Chemical Industries show, the Podbielniak Inc. centrifuge (or better known as the Podbielniak Contactor) is used for mixing, separating, washing clarifiying, neutralizing, decolorizing, acid treating chemical reacting and solvent extracting. From one to 15 countercurrent steps are permissible. Unit can be used in both liquid-liquid and liquid-solid seperations. Company guilds centrifuges and contactors for any desired capacity.

Kern Instruments For Engineering Offices

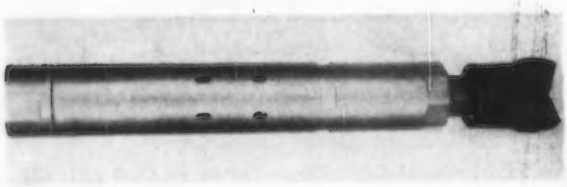
Kern Instrument Co, has available a catalog containing booklets on the double circle theodolites, the Invar subtense bar, double image telemetric outfits, surveyor's compass,

plane table equipment, NK levels the Kern Level Type GK-1, builder's levels, small survey instruments. Entire catalog is available, or you may request any of the individual booklets. Write direct to the company—Kern Instrument Co., 120 Grand St., White Plains, N. Y.

Microbalance Weighs Small Samples Accurately (4)

You can weigh small samples much more easily, quickly, accurately with the Cahn Electrobalance, says Cahn Instrument Corp. Gravimetric analyses may become much more effective with this improved weighing device. Less skilled operators can use it. Balance is in wide use in Canada at the present time. Instrument analysis is frequently so sensitive that it is performed with milligram quantities of sample. In this case the Cahn Electro-balance is a valuable asset.

Measurements are obtained by balancing the electrical force set up by the sample weight against a potentiometer and a galvanometer, then the voltage is measured and converted to true sample weight. Since the balance is calibrated with a known mass, measurements are in true mass units, independent of the local force of gravity. On 0 to 5mg samples, sensitivity is 1 microgram; accuracy is 2.5 micrograms. On 0 to 50mg samples, sensivity is 8 micrograms; accuracy is 30 micrograms.

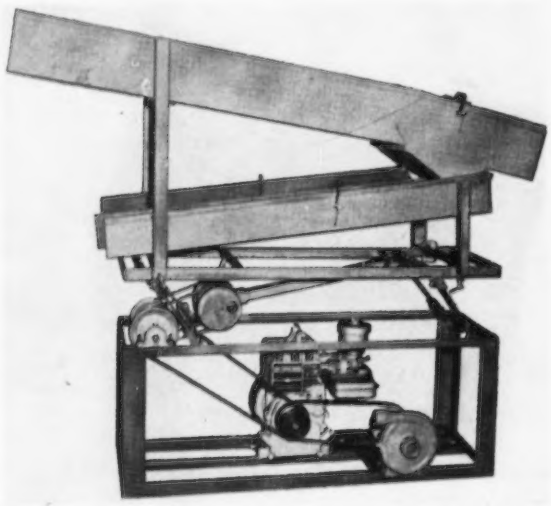


Down-The-Hole Attachment For Blast Holer (5)

Down-the-hole drill developed by Gardner-Denver Co. fits to any rotary air-flush blast hole drill in the 4¾ and 6½ in. dia sizes. Drill will cut with unusual speeds even the hardest formation or broken ground. Increased speed is due to the fact that all all the energy is exerted directly on the attached bit in the bottom of the hole, and that the drill has unusually good-hole cleaning ability. Gardner-Denver Co. has named the device the Mole-Dril. Tungsten carbide bit is attached directly to the drill with a short shank. Mole-Dril operates best on 100 psi air, and its hole depth is limited only by the air capacity needed to clean the hole.

Disc-Type Wet Reagent Feeder (6)

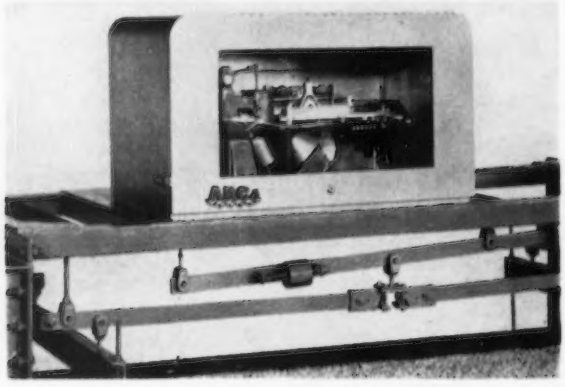
Disc feeder without cups or tilting bars is available from Knapp & Bates Ltd. Device uses stainless steel feeder discs that are wiped by two horizontal steel blades, one to each side of the disc. Typical four-feeder unit has a 4½-gal tank. Feed rate can be controlled from 0.3 to 15 gallons per hour per disc, based on creosote; one-third this rate for aqueous.



Concentrators Save Fines, Heavy Minerals (7)

Scott Concentrators has available several mineral concentrators for your consideration. Scott Heavy Mineral Concentrator (above) is available in a wide range of sizes with capacity from 50 yd per hour down to one-man prospecting models with ½ yard capacity. In operation, the top vibrating hopper washes and screens out the gravel and oversize. Lower sluice tray recovers the fine gold and heavy minerals by a series of countercurrent vibrating impacts.

Scott also makes the Scott Amalgamator and the Scott Magnetic Separator that will function in water, oil or air media. Amalgamator sizes range from ½- to 25 yd per hour. Magnetic Separator sizes run from 1-to-30 up to 250-to-350 per hour.



To Weigh, Control, Totalize Bulk Solids (8)

Belt scales by ABC Scale Div., McDowell Co., Inc., are built to an accuracy of ½ to 1% flow over their entire weight range. Units are available for any belt width and are built from standard components. Any capacity is available. Scale is housed in dust-sealed compartment with access door. McDowell Co. makes pelletzing and sintering equipment.

Longyear

Bringing up core . . . with drill rods *in the hole*

Longyear Wire Line equipment allows more drilling time per shift . . . improves core recovery!

Another core sample heading for the box and the crew about to go for more *without pulling up the drill string*. That's drilling with Longyear Wire Line equipment!

Drillers using the Longyear Wire Line Core Barrel lower an "overshot" through the drill string to bring up the Inner Tube containing core. Here's what this can mean to *your* operation:

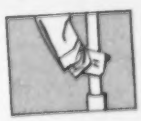
1 The drill string normally remains in the hole except when it is necessary to replace the bit. This eliminates much of the hard labor of drilling and allows more actual drilling time per shift.

2 Caving, the major cause of blocking and bit damage, is minimized. There is little chance for caving while the drill string is in the hole—which is most of the time.

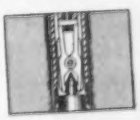
3 Longyear Wire Line Core Barrels are equipped with the water shut-off valve. In closed circuit drilling (possible with Longyear transmission pumps), the shut-off valve gives an immediate, positive indication of a block in the core barrel, eliminating costly "hunches" on the part of the drill runner.

Wire Line experience includes hundreds of thousands of feet drilled in many kinds of formations. Reports consistently show lower costs per foot of core recovered. In one overseas operation, switching from conventional NX equipment to BX Wire Line increased footage from ten to forty-seven feet per shift. In most cases when drilling in ground that is difficult to core, Wire Line improves core recovery substantially.

Looking ahead to your next drilling project, keep in mind that Longyear offers a complete line of Core Barrels and expert technical assistance in the selection of the right equipment for the formation you want to drill.

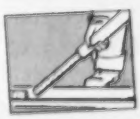


At end of core run, overshot assembly is lowered by wire through drill string.



At bottom drill string, overshot latches on to spear of inner tube.

Core-bearing inner tube reaches the surface, is freed from overshot.



Core is removed. Meanwhile, stand-by inner tube is dropped into the hole so drilling can be resumed as soon as it is in position.

Longyear

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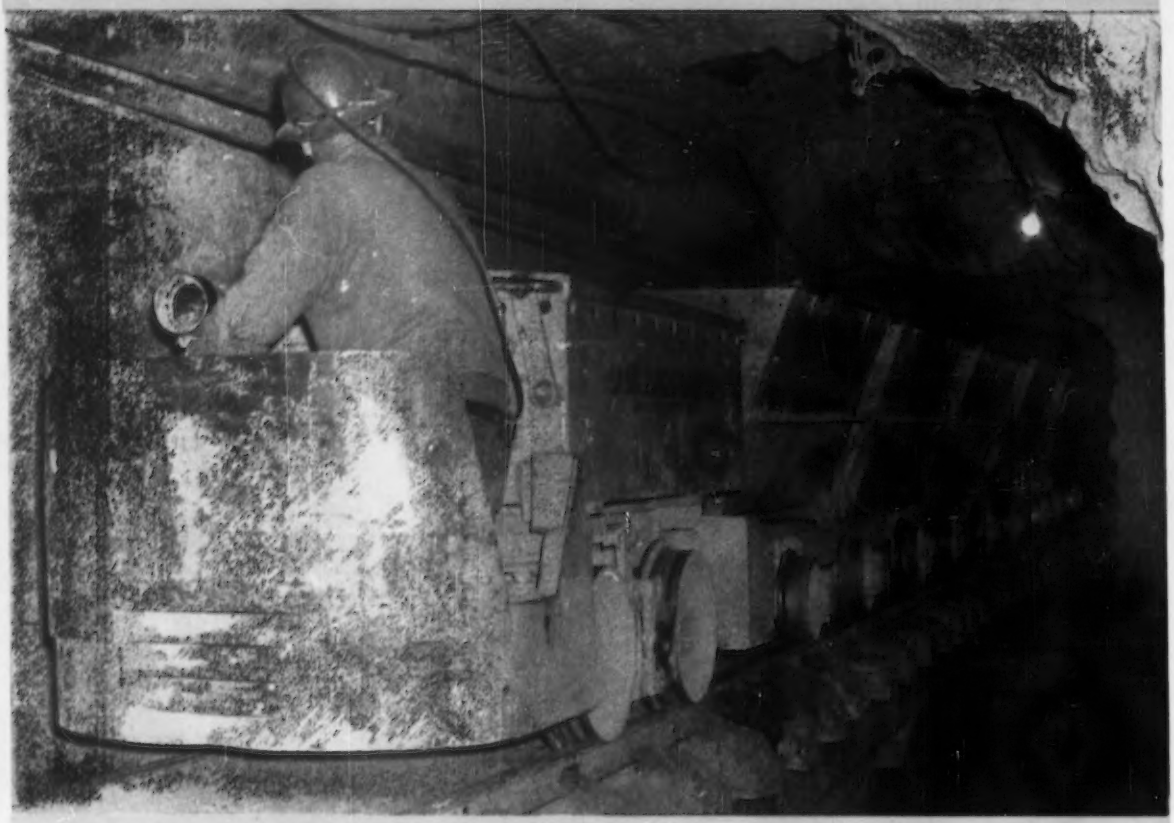
THE WORLD IS OUR WORKSHOP

MANCHA STORAGE BATTERY LOCOMOTIVE



Expediting Track Haulage of Uranium Ore

In the uranium rich areas of the Colorado Plateau and Canada's Blind River District 25 recently delivered Mancha 3-ton storage battery locomotives are providing low cost underground haulage.

Practical anywhere underground, these locomotives are maneuverable enough to service loaders in development headings . . . powerful enough to handle small mine production tonnage. Six to ten rocker dump cars, each carrying 1½ to 2 tons of ore is not an unusual load, and 150 tons per shift over a distance of 1,000 feet is just another job to them.

Mancha's patented Trackmaster design smooths out uneven track . . . cushions the battery as well as the motorman from a rough ride. More so, it improves overall performance by providing even drawbar pull to all four wheels through longitudinal equalizers and self-aligning journal bearings. The motor in the front end cast steel cab, is hooded to shed water and muck. A similar hood protects the controller.

In all respects, the Titan BN (3-ton operating weight) is a powerful—safe locomotive. What it provides in haulage economy for others, it can provide for you. Your inquiry is invited.

MANCHA STORAGE BATTERY LOCOMOTIVE

DIVISION GOODMAN MANUFACTURING COMPANY

Halsted Street and 48th Place • Chicago 9, Illinois • Cable Address: Mancha, Chicago

Mancha representatives are located in principal mining areas throughout the world.

Mining Equipment News

Core drill, developed by Wink Corp., weighs only 37 lb, yet can drill to 200 ft using 5/16-in. bits. Larger core diameters up to 6 in. are possible. An overhead drive principle allows up to 10-ft strokes without rechucking. Pentration speeds in excess of one foot per minute have been obtained at 100 ft depth. Motor is 2-cycle, 5¼ hp gasoline. All angle drilling permissible. **(9)**

Hard surfacing method announced by Kennametal Inc., called Kenplate, consists of small hexagonal plates of cemented tungsten carbide assembled in a continuous pattern on an adhesive glass fiber backing to provide flexible sheets or strips for application to flat or curved surfaces. Can be used for grinding mill and chute liners. **(10)**

Truck-mounted rotary compressor—Davey Compressor Co. has a new model that is driven from the truck motor. Auto-Air weighs 915 lb, and is rated at 125 cfm. **(11)**

Gasoline-driven electric plants—D. W. Onan & Sons, Inc. offer a new series of water-cooled, revolving-armature 10 and 15 kw electric plants. Motor is 41 hp. Voltages up to 460 are possible. **(12)**

Soil-testing apparatus—Soiltest, Inc. has a bulletin describing their concrete and soil testing aids. **(13)**

Underground dump truck—can carry 2½ tons according to Getman Brothers. Powered by 2-cylinder 20 hp, air-cooled Deutz engine, unit has four speeds each way. **(14)**

Electromagnetic survey instrument—Kellogg Exploration Co. has developed a light-weight, portable unit for detecting sulphide orebodies. Unit can be operated by two men. Variable frequency is used to compare conductivity. **(15)**

Rotary blast hole rig—Joy Manufacturing Co.'s Model 125—combines mechanical and high torque reversible hydraulic motor and air compressor. **(16)**

Front end loader—Euclid Div., General Motors Corp. offers a model with rated bucket capacity of 19 cu ft (14 cu ft struck). This is the first and smallest in size of a series to be established by Euclid. **(17)**

Portable explosives magazine that can be hauled by a light truck or tractor has been developed by Austin Powder Co. Magazine has five doors, can carry 8- to 10,000 lb load. **(18)**

Wire-reinforced steam line (burst-proof) for saturated steam service to 200 psi, or for superheated service to 385 deg F, is now available from Acme Rubber Manufacturing Co., Div., Acme-Hamilton Manufacturing Corp. **(19)**

What's New in Earthmovers

World's largest rear-dump semi trailer trucks—five 64-ton Kenworth 803-B's were delivered to Kaiser Steel's Eagle Mountain iron ore mine. Five more are to follow. Model 803-B is powered by 400 hp, 12-cylinder diesel engine. **(20)**

Bottom-dump trailer with 40-ton capacity (four times trailer weight) has been developed by Athey Products Corp. Trailer has a third or rear door that opens with the bottom doors and allows material to leave the rear area. **(21)**

Drop-door side-dump trailer—Easton Car & Construction Co. has adapted their Model TD-1115 trailer (15-ton) off-highway unit for over-the-road use. **(22)**

Caterpillar tractor and lowbowl scraper—Caterpillar's DW15 and No. 428 are described in literature now available from the company. **(23)**

Auxiliary News Briefs

Vehicular desk and night light that fits to auto or truck dashboards are now available from Product Development Corp. Desk has clipboard and extra work basket, plus ball point pen on a chain. Nite-light operates on either 6 or 12v. **(24)**

X-Y recorder—Bristol Co.'s electronic Dynamaster records on a strip-chart a continuous curve showing the relationship of one variable to another, such as temperature-pressure. **(25)**

Diaphragm meter that is unaffected by temperature variations within the metering liquid is now available from Foxboro Co. Type 37 has a bimetallic compensator to vary liquid capacity according to temperature changes. One pair of diaphragms control low pressure (range) and another pair takes care of high pressure (compensating). **(26)**

Porta-Trace fluorescent-illuminated tracing board can be had in three by four feet overall dimensions. Unit is equipped with a string-type parallel rule to make it a completely self-contained drafting unit. **(27)**

Submersible pump can handle 20% solids feed, says Sumo Pumps, Inc. Pump is adaptable for filter screen sump service, mine dewatering, water supply, etc. Pump has rated capacity of 460 gpm at 15 ft head. **(28)**

Fractional horsepowered, geared motors can be obtained from Merkle-Korff Gear Co. Company will now carry its line of motors in distributor's stocks, reducing delivery time considerably. **(29)**

For more information on these items, use card opposite p 42.

A COMPLETE REFRACTORIES SERVICE . . . *for the Copper Industry*

Three types of basic brick—RITEX, GREFCO, STEELKLAD for the three basic processes—smelting, converting and refining. Each type of brick available in the ranges of composition—Magnesite, Magnesite-Chrome, Chrome-Magnesite and Chrome—required to adapt to variations in metallurgical processing.

RITEX—chemically bonded for low cost, superior workmanship, resistance to spalling, ready availability.

GREFCO—conventional type bonded by tunnel kiln high temperature firing, for maximum strength and hardness.

STEELKLAD—steel encased on two, three or four sides and for special jobs, steel plates incorporated in the brick interior as well—for maximum resistance to spalling in the most severely treated exposed walls.

RITEX, GREFCO and STEELKLAD—each the result of many years of intimate knowledge of the copper industry and careful study of service conditions, each prepared from the best available raw materials and made with the most modern manufacturing facilities—all within easy access to your operation.

GENERAL REFRACTORIES CO.
Philadelphia 2, Pa.

GENERAL REFRACTORIES

E&MJ NEW PRODUCTS DIGEST (*Continued*)

Protective coating—Mono Seal Products has a blended silicone-epoxy type plastic that shows outstanding corrosion, impact, weather and moisture resistance. Will not chip or peel when bent or dented. Comes in three-part package. Can be brushed or sprayed or even dip applied. **(30)**

Do you have time to read? Gardner-Denver Co. will publish *Mining Clipboard* to provide a quick, easy glance at new mining techniques and Gardner-Denver developments. **(31)**

Mobile Machine shops designed by Davey Compressor Co. are described in a bulletin now available from the company. **(32)**

Synchronous induction motors—Syncro-Spede—are available in the same NEMA frame size as a standard motor of equal horsepower, according to Louis Allis Co. Motor accelerates as an induction motor, but runs at exact synchronous speed without permanent magnets or dc excitation. Sizes from 1 to 100 hp. **(33)**

To join dissimiliar nonferrous metals, try InterAct, says Intertectics Inc. Material joins by forming a permanent chemical bond (by ion exchange) between such materials as magnesium, titanium, brass, zinc, copper, aluminum, etc. This is not a soldering, welding or brazing method. **(34)**

Precision timing instruments handled by M. Ducommun Co. can be examined through their catalog No. 257. **(35)**

Metal and Mineral Processing Equipment Shorts

Portable aggregate screening plant—two new models are available from Pioneer Engineering, Div., Poor & Co. Matching feeder and conveyor with a 3x6 or 4x8 screen can be had. **(36)**

Portable crushing and conveying plant with hydraulic drive system is offered by Lippmann Engineering Works, Inc. Crushers are V-belt driven; all other units can be hydraulic drive. **(37)**

Spray nozzle that provides 120 deg spray angle can be obtained from Spraying Systems Co. Fulljet design can be used for rinsing, cooling, foam breaking, dust control, fire fighting. Available in twelve capacities from ⅛ to 3 in. pipe thread connections. **(38)**

Slurry pump—Krogh Pump & Equipment Co., Inc.'s Model 600 is a heavy duty full lined sand and slurry pump equipped with wear-resistant liners, replaceable and interchangeable with either hard metal or rubber. Sizes from 2 to 8 in. with capacity from 20 to 2,000 gpm up to 100 ft head or more. **(39)**

Bucket elevator—incorporation of a vertical slide in the boot section of the new bucket elevator being produced by Carpco Manufacturing, Inc. minimizes overloading, jamming and plugging. **(40)**

Reverse jet dust collector—redesigned to speed field assembly and installation, the Day AC reverse jet filter is available in sizes from 500 to 25,000 dfm capacity from the Day Co. **(41)**

Jaw crusher—Denver Equipment Co.'s Type H in sizes from 5x6 to 10x20 in. are now available with anti-friction bearings. Denver also states that company policy is to keep all sizes of the crusher in stock for immediate delivery. **(42)**

Automatic sulphur determinations are possible with Lindberg Engineering Co.'s Determinator. Endpoint is determined, simply, accurately and automatically by photoelectric cells. **(43)**

Denver Vezin-Type Sampler incorporates a cylindrical housing resulting in a more compact unit and reducing costs. Unit is designed for continuous sampling by taking all the stream, part of the time. Various sizes in single, double or multiple design are available. **(44)**

Pelletizing device—the Flying Cup by McDowell Co., Inc.—makes goose-eggs instead of marbles from iron ore or powdered chemicals. Typical Flying Cup is 10-ft dia by 6-ft deep, makes pellets larger than 1½-in. dia. Any capacity can be designed. **(45)**

Blends dry solids—Fuller Co.'s Airmerge Quadrant Blender blends by aeration of any solids that can be fluidized by compressed air. Unit is a round silo with air pipes distributed to provide fluidization. **(46)**

Flocculant—Good-rite K-720—in low concentrations causes rapid and thorough agglomeration of finely divided particles, according to B. F. Goodrich Chemical Co. **(47)**

Vinyl coating for elevator buckets, developed by Bauer Brothers Co., makes the buckets more self-cleaning. Vinyl protects against rust and abrasion, promoting longer bucket life and reducing maintenance where corrosive, abrasive, sticky or wet material is being handled. Bauer uses vinyl on their line of elevator buckets or custom coats. **(48)**

Rotameter—Sho-Rate by Brooks Rotameter Co., has 150 mm scale length for greater readability, according to latest bulletin. **(49)**

Literature For Sale

FILLER METAL comparison charts, comprehensive sheets on welding rod and electrodes, are available from the American Welding Society, 33 West 39 St., New York 18, N. Y. Booklet is 24 pp, contains the brand names, AWS-ASTM specifications, who makes it, where to get it. Write direct to the society, send money. Price $2.

What's Happening to Your Metal Markets?

E&MJ METAL AND MINERAL MARKETS

Keeps You Informed on Today's Prices . . . Trends

An authoritative weekly metal market price and information service published by *ENGINEERING AND MINING JOURNAL* for producers, buyers and sellers of nonferrous metals, ores and minerals.

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E&MJ editors report and interpret for you the significant factors in the constantly changing market picture, analyzing and summarizing the wealth of information they secure from daily contact with key industry people.

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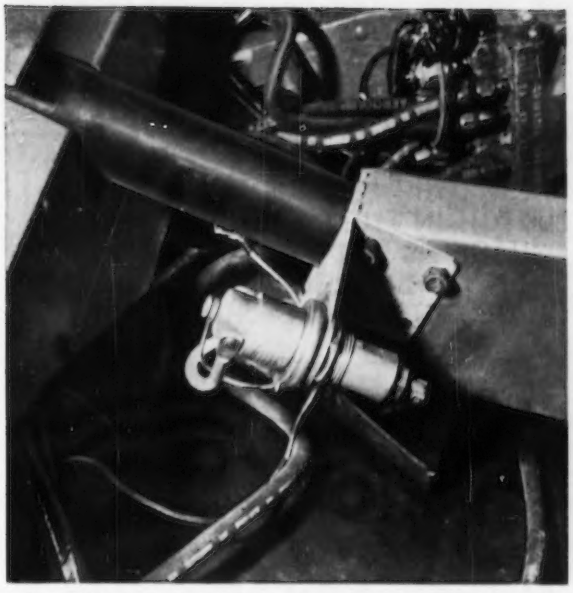
The Engineer's Field Report

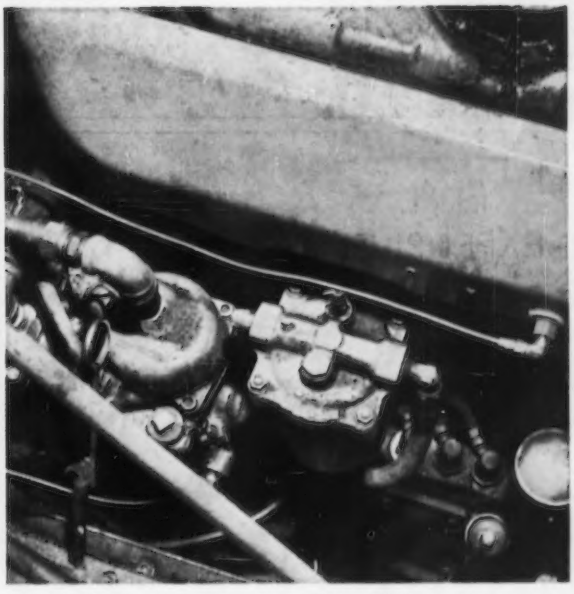
CASE HISTORY

PRODUCT Chevron Pressure Primer System

FIRM Consolidated Freightways Inc., Portland, Oregon

Pressure Primer System starts diesels on 1st or 2nd turn with regular batteries—at minus 40°





BELOW ZERO starting temperatures are common 5 months a year for Consolidated Freightways equipment operating in Mountain and Plain States. Two hundred and forty-four of the company's tractors are equipped with the Chevron Pressure Primer System. Since this installation, rigs start on first or second turn at 40° below zero—using regular equipment batteries! Normally in these sub-zero temperatures, regular batteries give out after about 4 turns. Sure starts plus the fact engines are primed with Chevron Pressure Primer bulbs, controlled from within the cab, saves Consolidated Freightways important man-hours and speeds operating schedules. Picture above (left) shows a Chevron Pressure Primer Discharger mounted on steering column. Highly volatile priming fuel is atomized through tubing into manifold (right) under 250 lbs. pressure.

FREE FOLDER tells you more about Chevron Pressure Primer System and how to install it on different engines. Write or ask for it today.

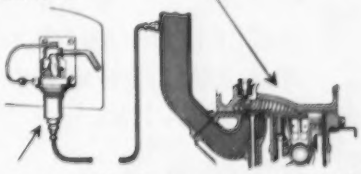
FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor, write or call any of the companies listed below.

CHEVRON

TRADEMARK "CHEVRON" AND CHEVRON DESIGN REG. U.S. PAT. OFF.

Why Chevron Pressure Primer System helps starting

Volatile Chevron Priming Fuel atomizes in induction system at temperatures as low as -65°F. Pressure or weakest spark from engine fires mixture.



Simple, rugged discharger prevents fuel leakage. Small, safe steel bulbs protect fuel from water and dirt.

STANDARD OIL COMPANY OF CALIFORNIA, 225 Bush Street • San Francisco 20, California

THE CALIFORNIA COMPANY, P. O. Box 780 • Denver 1, Colorado

STANDARD OIL COMPANY OF TEXAS P. O. Box 862 • El Paso, Texas

THE CASE OF
THE IDEA THAT SAVED TWO DAYS
...I'M GOING TO LOSE ABOUT TWO DAYS WHILE WE REBUILD THAT FLYWHEEL CLUTCH!
CATERPILLAR
WHY SHOULD YOU? PUT IN A REBUILT ASSEMBLY FROM OUR EXCHANGE STOCK AND YOU'LL HAVE YOUR TRACTOR GOING THIS AFTERNOON!
CAT
IS IT EXPENSIVE?
NOT AT ALL...
--YOU PAY ONLY FOR THE PARTS AND REPAIR SERVICE TO PUT YOUR CLUTCH IN THE SAME FIRST-CLASS SHAPE AS THE EXCHANGE UNIT. THEN YOUR REBUILT ASSEMBLY GOES INTO OUR EXCHANGE STOCK.
EXCELLENT IDEA! GO AHEAD...
THAT AFTERNOON
SURE AM GLAD I FOUND OUT ABOUT YOUR PARTS ASSEMBLY EXCHANGE PLAN, ART!
WE HAVE OTHER ASSEMBLIES ON HAND TOO, JIM. IT'S AN IDEA THAT REALLY SHORTENS DOWN TIME!
CATERPILLAR*
*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.
CAT CARE FOR LONGER WEAR
LET ME HELP KEEP YOUR CAT* EQUIPMENT ON THE JOB!
Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

For More Details on New Product Items Starting on p 35 and For Copies of Free Literature Listed Below –Circle the Proper Number on Card. Be Sure to Give Your Name and Address, Then Mail to *E&MJ*

For Your Files

This selected manufacturers' literature is free unless otherwise specified. If item is for sale, send request and money direct to manufacturer.

Exploration and Mining

SOIL SAMPLING EQUIPMENT bulletin No. 300 describes in detail the soil samplers and accessories manufactured by Sprague & Henwood, Inc. 24 pp. **(50)**

EXTENSIBLE BELT CONVEYOR catalog G-123, prepared by Goodman Manufacturing Co., illustrates the use and design of Ropex conveyors in eight pages. **(51)**

HYDROVANE ROTARY COMPRESSORS, Davey Model 125, are covered in Davey Compressor Co.'s 4-page bulletin. **(52)**

ROTARY AIR COMPRESSOR developed by Le Roi Div., Westinghouse Air Brake Co. is described in a 2-color, 8-page bulletin. **(53)**

OFF-HIGHWAY HAULERS available from International Harvester Co. are illustrated in a 16-page catalog. Models 95 and 65 Payhaulers are described. **(54)**

DIESEL POWER UNITS from International Harvester Co. are described in a 12-page catalog. **(55)**

CRAWLER-MOUNTED EARTHMOVERS in the International Harvester Co. line are presented in a 16-page catalog. Rubber-mounted equipment is also included. **(56)**

PREVENTIVE MAINTENANCE and operative maintenance of crawler-type tractor parts are featured in Sight Feed Generator Co.'s 6-page brochure. **(57)**

Auxiliary Equipment

STEAM TURBINE-GENERATORS, their design and application, are the subject of General Electric Co.'s 2-color, 54-page bulletin No. GEA-3277D. **(58)**

VERTICAL SHAFT MOTOR-GENERATORS, designed by Kato Engineering Co., are detailed in the company's latest literature. Folder covers 500w to 250 kw motor-generators. 4 pp. **(59)**

ELECTRIC GENERATING PLANTS are the subject of D. W. Onan & Sons Inc.'s revised "Blue Book" of general information concerning generator selection. Booklet is 31 pp. **(60)**

ELECTRIC OVENS, furnaces, baths and related temperature controls are covered in Blue M Electric Co.'s catalog No. M-57. Booklet is 45 pp. **(61)**

HOW TO USE saturable power reactors, a 32-page bulletin F-8383 prepared by Barber-Colman Co., is available for the asking. With proper temperature measuring instruments and a dc source, it is possible to measure and use a saturable reactor to ac-powered equipment. **(62)**

TOOL ROOM GRINDING of alloy, high-speed and die steels is detailed in Carborundum Co.'s excellent, indexed 26-page guide. **(63)**

PRECISION TOOL catalog published by Right and Left Tools contains 32pp of precision-built tools for the machinist. **(64)**

V-BELT DRIVE bulletin is a manual containing all V-drive information previously available in Dodge Manufacturing Corp.'s general engineering catalog. Tables have been expanded, new material added. 108 pp. **(65)**

VERTICAL HOLLOW-SHAFT MOTORS in the Louis Allis Co. line are detailed in a 4-page bulletin. **(66)**

MOTOR CONTROL bulletin by Allis-Chalmers Manufacturing Co. describes high voltage starters, Type H, for 2300 to 5000v motors. 8 pp. **(67)**

ELECTRIC CLUTCHES AND BRAKES are covered in Warner Electric Brake & Clutch Co.'s 8-page catalog digest WEB 6292. **(68)**

ROTARY VANE PUMPS, Models 2, 3 and 6 in the Dexter Folder Co. line, are described in 4-page folder. **(69)**

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Please send me the catalogs or further information about the items from New Products Digest whose numbers are circled. **DEC. 1957**

1	15	29	43	57	71	85
2	16	30	44	58	72	86
3	17	31	45	59	73	87
4	18	32	46	60	74	88
5	19	33	47	61	75	89
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7	21	35	49	63	77	91
8	22	36	50	64	78	92
9	23	37	51	65	79	93
10	24	38	42	66	80	94
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12	26	40	54	68	82	96
13	27	41	55	69	83	97
14	28	42	56	70	84	98

Name .....

Title .....

Company .....

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E&MJ NEW PRODUCTS DIGEST (*Continued*)

CENTRIFUGAL PUMPS, Class GT, manufactured by Ingersoll-Rand Co., are illustrated in a 16-page 2-color bulletin. **(70)**

Metal and Mineral Processing

CIRCULAR CONCENTRATOR for gravity and flotation beneficiation, the Cannon concentrator, is the subject of 4-page reprinted article presented by Felix J. Losson, Jr., at the Southeastern AIME meeting. Copy can be obtained from Cannon Concentrator Co. **(71)**

HEAVY-MEDIA SEPARATION vessel, designed by Ore & Chemical Corp., is detailed in a 6-page release. **(72)**

VIBRATING SCREEN bulletin No. 757, published by Stephens-Adamson Manufacturing Co., is 8 pp, contains data and illustrations on their vibrating units. **(73)**

GRAPHITE RECOVERY FLOWSHEET prepared by Denver Equipment Co. describes the recovery of graphite and the equipment needed for a 125-tpd mill. **(74)**

BELT PULLEYS, manufactured by Van Gorp Manufacturing, Inc., are illustrated in a 16-page catalog. **(75)**

PUMPS FOR YOUR FILTER PRESSES is the title of a technical data sheet, No. T4, prepared by T. Shriver & Co., Inc. Illustrated in 8 pp. **(76)**

HOW A ROTARY VACUUM FILTER handles aluminum hydroxide slurry is the title of 2-page reprint available from Filtration Engineers, Inc. **(77)**

FILTER CLOTH catalog prepared by National Filter Media Corp., contains data on all types of fabric. 8 pp. **(78)**

LABORATORY EQUIPMENT catalog is available from Will Corp. 16 pp. **(79)**

SURFACE CONDENSERS, designed for efficient production of vacuum for prime mover service on large steam turbines, are illustrated in Southwestern Engineering Co.'s 4-page release. **(80)**

BUCKETS AND HOPPERS in the Penn Iron Works, Inc. line are illustrated in a 4-page release. **(81)**

DUST CONTROL FOR INDUSTRY, bulletin No. 922, prepared by Pangborn Corp., contains 15 pp of dust control hints, aids and equipment. **(82)**

REVERSE JET FILTER, the Retroflux dust collector manufactured by Hazemag, is illustrated in several folders prepared by the company. **(83)**

EXAMPLES of Wheelabrator Dustube installations are shown in the latest issue of *Dust and Fume Topics,* published by Wheelabrator Corp. **(84)**

AERODYNE DUST COLLECTOR, designed and manufactured by Green Fuel Economizer Co., Inc., collects dust in a cone-shaped, louvered filter, according to 8-page bulletin No. 171. **(85)**

CERAMIC FILTER, designed to provide dust-free air at temperatures up to 2300 deg F, in units with up to 1000 cfm capacity at 0.8 in. water gage, are available from Flanders Filters Inc., according to their literature. **(86)**

HOW MUCH ARE YOU PAYING FOR DUST? is the title of Torbit Manufacturing Co.'s latest release on cloth filter and cyclone dust collectors. **(87)**

GUARTEC for the mining industry shows the use of Guartec in ore concentration filtering and settling problems. 16 pp. From General Mills, Inc. **(88)**

HINGED-STEEL BELTING bulletin describes May-Fran Engineering, Inc.'s complete line of belting. 6 pp. **(89)**

HIGH TENSION BELTS and conveyor and transmission belting by Boston Woven Hose & Rubber Co. are described in folders now available from the company. **(90)**

FLEXIBLE PVC TUBING is described in Newage Industries, Inc.'s leaflet on Bardex tubing. Available in six diameters from ⅛ to 1 in. **(91)**

INDUCTION MELTING FURNACES, Ajax Engineering Corp.'s 60-cycle Ajax-Junker coreless melting furnace for ferrous and nonferrous metals, is detailed in a 4-page folder. **(92)**

X-RAY SPECTROGRAPH, a reprinted article from the *ISA Journal* illustrating use, routine and problems of the spectrograph X-ray, is available from Philips Electronics, Inc. Philips also has a 12-page catalog on the X-ray unit. **(93)**

INERT GAS GENERATORS that operate on gas or oil are available in a wide variety of sizes, according to literature prepared by Thermal Research & Engineering Corp. 4 pp. **(94)**

POLYVINYL CHLORIDE PIPE is illustrated and catalogued in Alpha Plastics Inc.'s 12-page catalog. **(95)**

DATA PROCESSING SYSTEM, Beckman Model 112, is the subject of a 6-page brochure now available from Beckman Instruments, Inc. **(96)**

You can get

Positive Rotation Firing with Ignitacord®

Cut your safety fuse to uniform lengths. Cap one end and crimp an Ignitacord Connector on the other. After the holes are loaded, measure off the Ignitacord (it is color-marked at one foot intervals) and connect it to each fuse Connector so as to give you positive rotation firing. Light the Ignitacord with a match and go away from there!

The Ignitacord will burn progressively like a hot wire lighter, giving off an intensely hot flare at the zone of burning.

This flare will ignite each Connector which in turn will ignite each fuse.

You'll get a series of shots timed correctly. You'll save safety fuse. You'll enjoy greater safety, too.

This Ignitacord booklet tells the story clearly: what it is and how to use it. Write for a copy — it's free. Purchase Ignitacord and Connectors through your explosives supplier.

THE ENSIGN-BICKFORD COMPANY

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Primacord® and Detacord® Detonating Fuse, Safety Fuse, Ignitcord®, Quarrycord, Pyrotechnical Devices and Blasting Accessories

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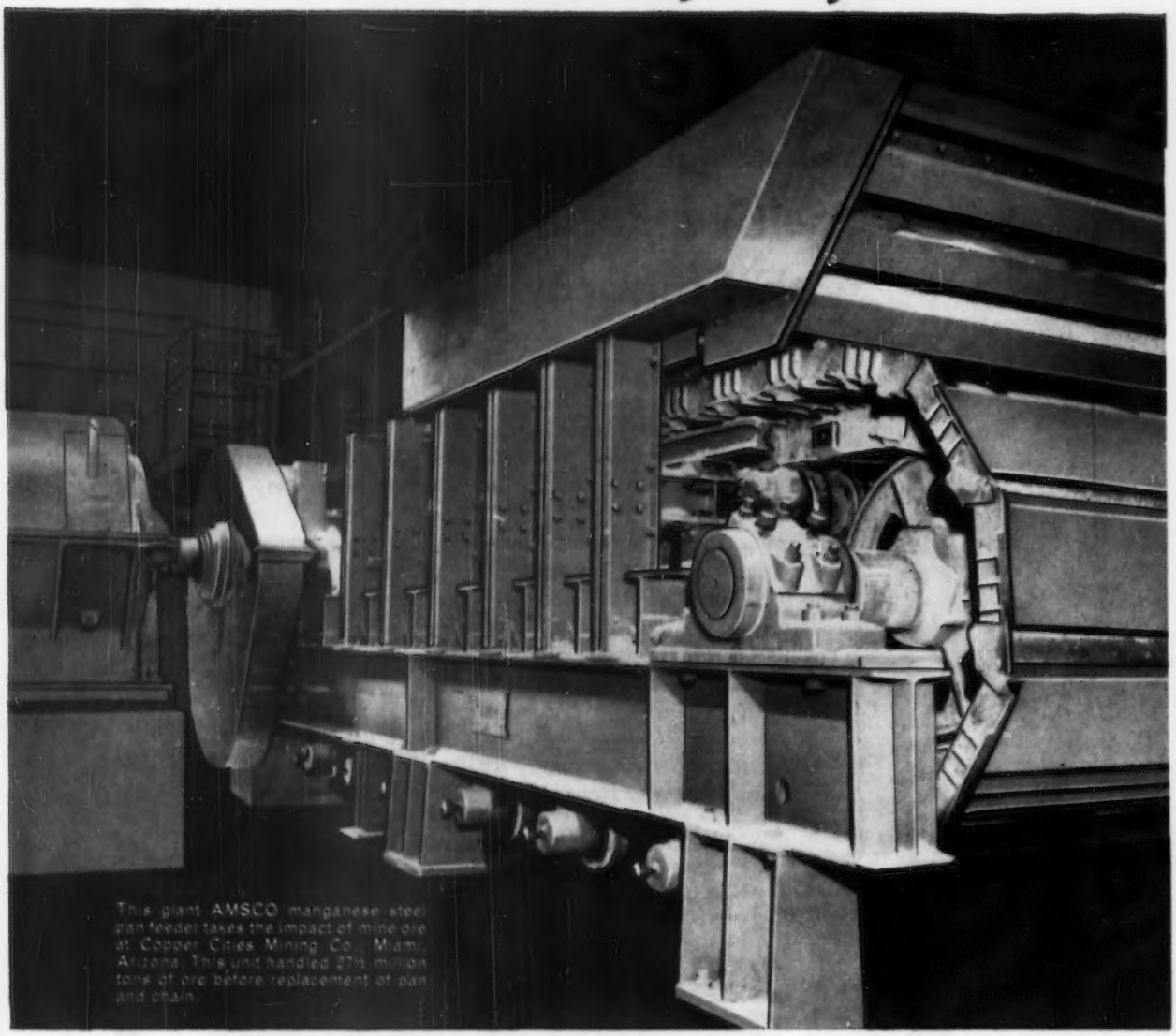
and CONNECTORS

10-1

STEPHENS-

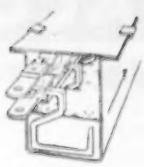
heavy duty ahead



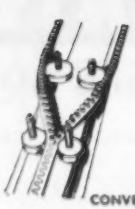
This giant AMSCO manganese steel pan feeder takes the impact of mine ore at Copper Cities Mining Co., Miami, Arizona. This unit handled 27½ million tons of ore before replacement of pan and chain.

BELT CONVEYORS

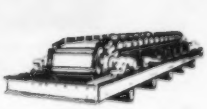
VIBRATING CONVEYORS



REDLER CONVEYORS, ELEVATORS



ZIPPER CONVEYOR-ELEVATORS



PAN CONVEYORS

BUCKET ELEVATORS

BIN GATES—ALL KINDS

-ADAMSON

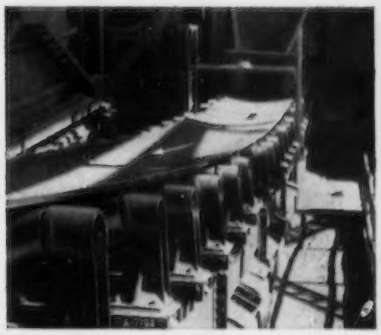
for your ore conveyor system

How will you move a lot of ore under or over the ground, thru processing, in and out of storage, to and from shipping—move it fast, at the least cost?

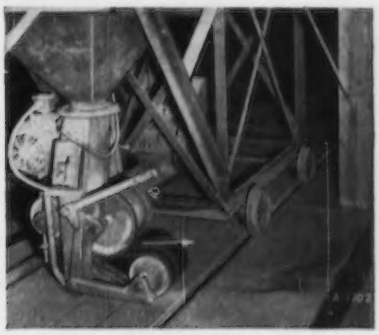
Mechanization is the way, the S-A way, and it's done by close prior study of your requirements by the best engineering brains in the bulk material conveying industry. These men are backed by a quality line of material handling and conveying equipment designed to move any type of ore in any quantity.

Long range planning of your ore handling needs is important. This calls for a conveyor system engineered for the years to come. You can find these kind of STEPHENS-ADAMSON systems everywhere in the world, moving all kinds of ore products at rock bottom cost.

Wherever you are, S-A engineers can design, build and install your conveyor system. They are available to work with your engineers or with your consultants.



A South American copper mine has been using an S-A system for 25 years. The original installation totals 18,485 feet and in terms of ore delivered is in the multimillion ton class. Six Amsco feeders are included in the system. S-A carriers, probably the largest ever built, weigh almost 1000 lbs. each.



Handling a wide variety of zinc ores, a complete S-A system conveys to storage by means of feeders, bucket elevator, shuttle conveyor, and centrifugal pilers. SACO speed reducers are used on all conveyor drives and spring type belt wipers keep belt surfaces clean. Close-up here shows centrifugal thrower.

SINCE 1901 S-A STEPHENS-ADAMSON MFG. CO.

STEPHENS-ADAMSON MFG. CO.

4 RIDGEWAY AVENUE, AURORA, ILLINOIS
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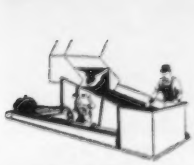
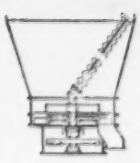


VIBRATING SCREENS



CIRCULAR BIN DISCHARGERS

SEALMASTER BALL BEARING UNITS

S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

Belt Conveyors
Belt, Pan & Plate Feeders
Ship Loading Boom Conveyors
Stacking Conveyors
Storage & Reclaiming Systems
"Natural Frequency" Vibrating Conveyors
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Conveyor Belt Cleaners
Headshaft Holdbacks
Grizzlies & Screens
Centrifugal Pilers
Bin Gates & Tunnel Gates
Car Pullers & Spotters
Bucket Elevators
Skip Hoists
SEALMASTER Ball Bearing Units

• *Write for a bulletin on any of the above products.*

KOEHRING WORK CAPACITY *in action . . .*

A new 2-yard — Latest addition to the big Koehring line of excavators for mining and quarrying is this new 805. It's a heavy-duty 2-yard machine, with 25-foot deep-section shovel boom, and 18½-foot dual dipper sticks. You'll like the 805's power, strength, stability in heavy digging — and *extra capacity* as a dragline or crane for stripping, stockpiling, lifting. It handles 2 to 3-yard dragline bucket — lifts up to 52 tons.

"Diving" for gravel — Loading out of a water-filled gravel pit (right), this 405 dragline puts production on a big-tonnage basis. It has plenty of work-radius for this type of operation — can be used with 40 to 90 feet of boom, and handles 1 to 1½ cu. yd. bucket depending on weight of materials. Check its other work capacities on opposite page, then let your Koehring distributor show you what the 405 will do for you.

Re-working a slag bank — Once cast aside as waste, slag is now being reclaimed from this bank, run through a crusher, and used as sub-base material on road construction. During the process, slag is swept by a magnet to remove any scrap metal. Here, a Koehring 1½-yard 605 shovel loads the slag into Dumptors for haul to crushing plant. This combination of Koehring shovels and Dumptors makes a heavy-duty, high-production team. 6-yard Dumptor® climbs 24% grades fully loaded, dumps in one second, travels at same high speeds in either direction — no need to turn.

Mining copper ore — At this open-pit mine in the Southwest, overburden has been stripped down to pay-dirt. Next, a Koehring ½-yard 205 loads out copper-bearing ore for haul to smelter. Powerful crowd, fast retract, smooth swing, and instant dipper-trip speed production in the pit, keep trucks on the run.

Here are some figures that will interest you:

KOEHRING MODEL	SIZE DIPPER	LIFT CAPACITIES (Crawler ratings based on 75% of tipping load. Rubber-tired machines — 85% of tipping load.)	
205 CRAWLER	½-Yd.	20,000 lbs.	at 10-ft. radius
205 ON RUBBER	½-Yd.	30,000 lbs. 14,600 lbs.	at 12-ft. radius at 20-ft. radius
305 CRAWLER	¾-Yd.	30,000 lbs.	at 12-ft. radius
305 ON RUBBER	¾-Yd.	50,000 lbs. 15,800 lbs.	at 10-ft. radius at 30-ft. radius
405 CRAWLER	1-Yd.	40,000 lbs.	at 12-ft. radius
445 ON RUBBER	(Crane only)	90,000 lbs. 40,000 lbs.	at 15 ft. radius at 25-ft. radius
605 CRAWLER	1½-Yds.	72,300 lbs.	at 12-ft. radius
805 CRAWLER	2-Yds.	104,200 lbs.	at 12-ft. radius
1205 CRAWLER	3-Yds.	190,000 lbs.	at 12-ft. radius

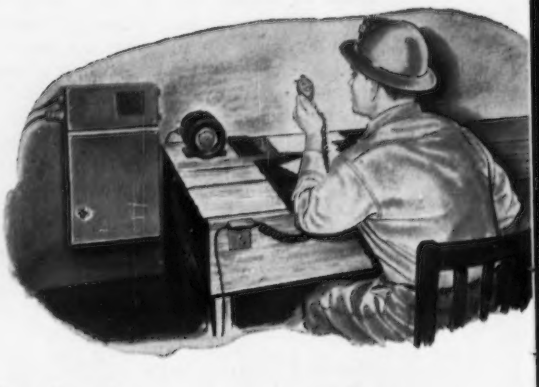
Want more information? *See Koehring distributor.*

KOEHRING DIVISION OF KOEHRING COMPANY, Milwaukee 16, Wis.

Boosts haulage efficiency and increases safety...

M·S·A MinePhone

The M.S.A. MinePhone is eliminating communication delays in mines everywhere. This clear, instant two-way voice communication system coordinates the wide variety of operations vital to peak production. Haulage moves faster because dispatcher and motormen are constantly in touch, even while trips are in motion. Shop and maintenance personnel are always "on call." And because messages are relayed instantly, on an open-line hookup, underground safety is increased. Write for details.



Assures accurate, safe, speedy hoisting operations...

M·S·A HoistPhone

The M.S.A. HoistPhone provides continuous, dependable and efficient voice communication between hoisting engineer and cage, at any level, and when in motion. The system is invaluable in emergencies, yet designed for day-in-day-out service. Ideal for passenger travel, load leveling, inspection trips, and construction work, the HoistPhone requires no special training; utilizes existing wiring. Write for complete details.

Permits emergency or temporary communications...

M·S·A Portable HoistPhone

A compact, integral unit that can be set up anywhere, and put into immediate service for clear, dependable voice communications. Its light weight and ease of operation make it ideal for temporary communications for inspection work or for emergency assignments. Write for details.

MSA
SAFETY EQUIPMENT HEADQUARTERS

When you have a safety problem, M.S.A. is at your service. Our job is to help you.

MINE SAFETY APPLIANCES COMPANY
201 North Braddock Avenue, Pittsburgh 8, Pa.
At Your Service: 77 branch offices in the United States and Mexico

MINE SAFETY APPLIANCES CO. OF CANADA, LTD.
Toronto, Montreal, Calgary, Edmonton, Winnipeg, Vancouver, Sydney, N.S.

TISCO®

MANGANESE STEEL CHAIN

COMBINATION CHAIN

TISCO combination chain is made of tough, abrasion-resistant manganese steel for extra long wear. Reinforced side bars provide more bearing area, reduce pin wear and cutting.

PINTLE CHAIN

Used in elevators, conveyors, etc., rugged TISCO pintle chain actually becomes tougher as it wears and is unsurpassed for durability.

DRAG CONVEYOR CHAIN

TISCO drag conveyor chain is noted for its phenomenal wearing qualities and is used for the horizontal transfer of heavy stone, cement, chemicals, etc.

DRAG LINE CHAIN

Embodying exceptional hardness and extremely long-wearing properties. TISCO drag line chain is designed to provide full bearing between links and outlasts others by 500%.

DETACHABLE CHAIN

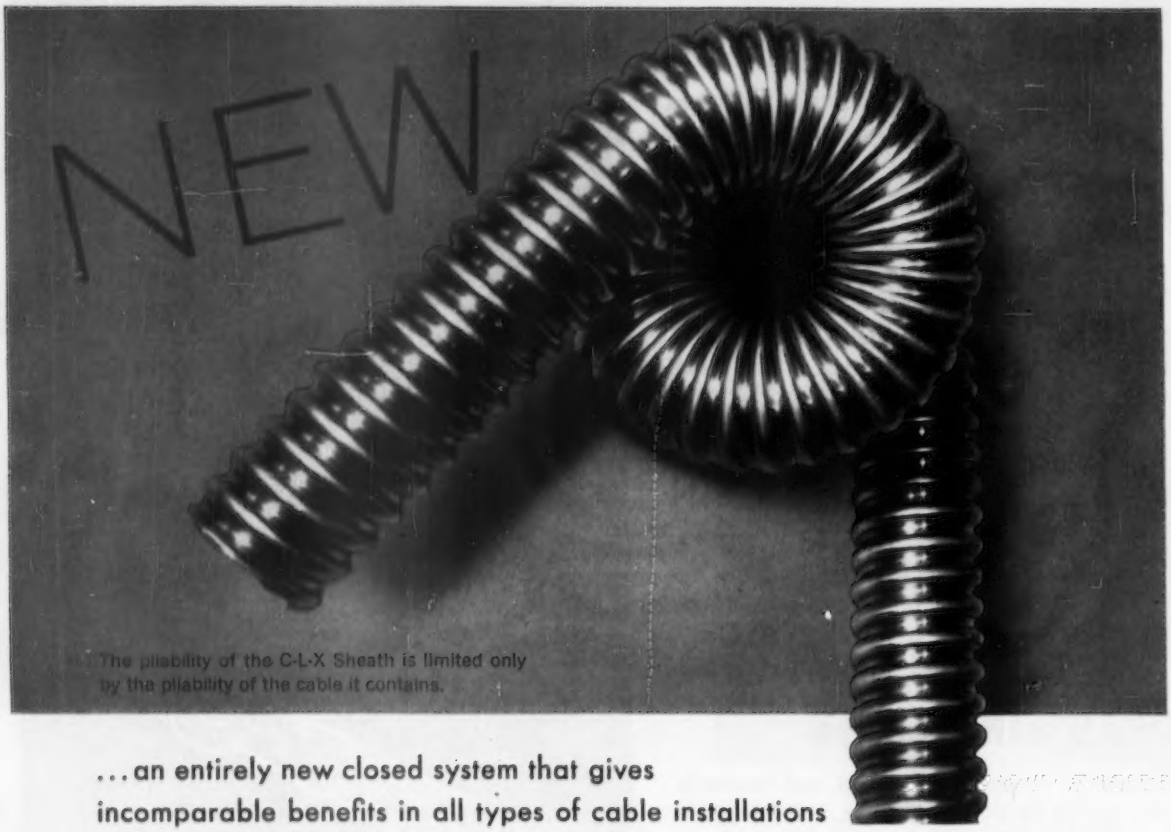
Used for light and moderate speed drums, conveyors and elevators, TISCO detachable chains are simple to assemble yet cannot become uncoupled while in service. For details on all TISCO manganese steel chains contact:

TAYLOR-WHARTON CO.

DIVISION OF HARSCO CORPORATION
Established 1742
HIGH BRIDGE 1, NEW JERSEY
PLANTS: Cincinnati, O. — Birmingham, Ala. — Easton, Pa.
SALES OFFICES: New York — Chicago — San Francisco

Simplex

ANNOUNCES the C-L-X* Sheath



...an entirely new closed system that gives incomparable benefits in all types of cable installations

Simplex C-L-X is a Continuous Lightweight eXterior metallic sheath that is impervious to gases, chemicals and water. Its unique construction gives it a combination of properties that is unmatched by any cable system now manufactured in the United States.

C-L-X provides a completely sealed conduit — with "built-in" cable. C-L-X combines all the advantages of lead sheathed and interlocked armored cables. In addition, it has its own intrinsic qualities of great strength with extremely light weight. It is suitable for installation in trays or by clamps. C-L-X can be used aerially or buried directly in the ground. Its pliability permits ease of installation.

For more than a decade, this type of cable protection has given exceptional service in European installations. *Now, Simplex engineering has adapted C-L-X so that its scope of industrial applications is practically unlimited for modern American installations.* It is unequalled in situations where impermeability and durability are important.

Like all Simplex products, C-L-X is engineered for lasting quality and, therefore, *dependability*. Write for specific product data.

*(Continuous Lightweight eXterior, pronounced "Sealex")

LIVE BETTER ELECTRICALLY

Simplex WIRE & CABLE COMPANY

79 SIDNEY STREET, CAMBRIDGE 39, MASS.

"the American manufacturers of transoceanic telephone cables"

It's a big-producing 2½-yd. LORAIN-85A for Fiala Crushed Stone

This Annville, Pennsylvania, quarry of Fiala Crushed Stone Corporation uses three Lorain Shovels for digging and truck loading to keep crusher output at a maximum. One of them is its new 2½-yd. Lorain-85A. To date, 9 Lorains have been purchased by Fiala.

Fiala knows the value of productivity and performance . . . that's why it chose the big Lorain-85A. It is a standout in any quarry. Here's what it offers:

BIG POWER—"Never-say-die, hang-on" power—that's what the Lorain-85A has with its torque converter that automatically matches engine torque to digging demands.

SIMPLE POWER CONTROLS—Lorain 2-lever, "Joy Stick" air power controls—reduce effort, reduce fatigue—increase speed, comfort and production.

NEW TURNTABLE MOUNTING—"Shear Ball" turntable mounting . . . like a huge, sealed "ball bearing" . . . eliminates all rollers, exposed roller path, center pin and nut with their constant requirements of adjustment and maintenance.

TWO CRAWLER CHOICES—One 15' 6" long x 11' 10" wide for general purpose service as shovel, crane, dragline or hoe. One extra-long and extra-wide—18' 6" x 14' 2"—for maximum lifting capacities as a crane and for wide-radius dragline and clamshell work.

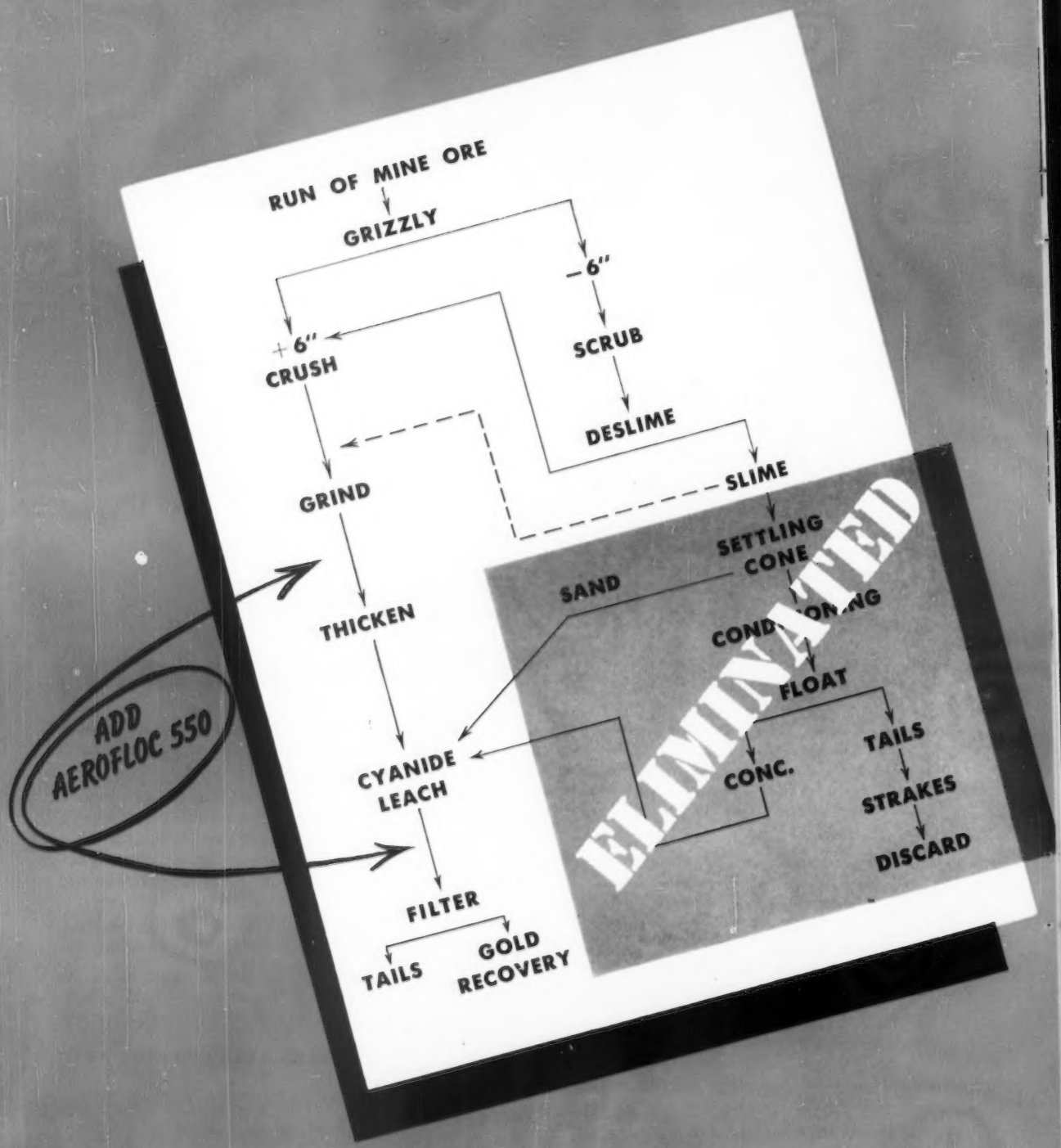
NEW CAB—New "operator-designed" cab for greater visibility, comfort, convenience—less fatigue.

These are a few of the features that make the Lorain-85A a big-profit machine. Your Thew-Lorain Distributor can tell you the whole story.

THE THEW SHOVEL CO., LORAIN, OHIO

THEW LORAIN®

PHILIPPINES GOLD PRODUCER FINDS AEROFLOC 55



550 REAGENT AN EXCELLENT SLIME CONTROLLER

Only 0.01 lb/ton increases gold recovery by 1.3% . . . Simplifies flow scheme by eliminating slime flotation

Every pennysworth of AEROFLOC 550 Reagent used at Baguio Gold Mining Company increases recovery by approximately 10 cents and eliminates slime flotation, too! Here's the step-by-step background of this interesting, profitable beneficiation development.

Baguio Gold treats 450 tpd of gold ore running 0.23 to 0.25 oz Au/ton by straight cyanidation with AERO® Brand Cyanide. Ore consists of gold with pyrite and some chalcopyrite in quartz-calcite veins in andesite and diorite.

Following its destruction during World War II, the 1933 mill was re-built in 1952. Primary slime trouble required the addition of a washing plant in 1954 to segregate 30 tpd of slimes running 0.25 oz/ton for treatment by froth flotation using AERO® Xanthates and pine oil. The concentrate was added to the grinding and cyanidation circuit and the slime tailing was discarded after straking. The exclusion of slime from the cyanidation circuit was an important factor in reducing cyanide consumption from 1.5 to 0.6 lb/ton.

In 1956, the experimental use of various AEROFLOC Reagents showed that flotation feed could be cut to 20 tpd with an increase in recovery of values in the flotation feed from 75% to 85%. Cyanide consumption held steady. In 1957, slightly increased dosage of AEROFLOC 550, fed as a 0.1% water solution to the thickeners ahead of the leaching circuit, made possible complete elimination of the slime flotation step. The whole ore is now cyanided with gain in gold recovery close to 1.3%, plus savings in power, reagents, labor and maintenance.

Such noteworthy gains are not always possible. But even in long-established flow schemes continued testing with the newer reagents can produce very worthwhile gains. Cyanamid Field Engineers stand ready to collaborate with mining companies in studying new and more efficient reagent combinations and other steps that might minimize costs-plus-tails.

CYANAMID

AMERICAN CYANAMID COMPANY
MINING CHEMICALS DEPARTMENT
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

DART SIMPLIFIES
Underground Haulage

DART'S 10-Ton Shuttle truck is designed for tunnel operation where space limitations require highest maneuverability. Shuttle controls permit truck to be driven in either direction at same speed. No necessity for turning truck around at loading machine.

Rugged construction of the 10S-UG assures low maintenance and high availability. Ease of operation reduces driver fatigue and increases payload cycles per day.

May we help you with your particular hauling problems?

GENERAL SPECIFICATIONS

Dart 10S-UG 6 Cu. Yd. Rock Body—10-Ton Capacity. Dart box girder frame—Cummins 125 HP diesel engine with Allison converter—semi-automatic transmission. Three speeds forward and same three speeds reverse. Tires are 12:00 x 20—16 ply rating front and rear. Twin double-acting hoists. Exhaust scrubber of 70 gallon capacity.

HEAVY DUTY TRUCKS EXCLUSIVELY SINCE 1903

DART TONNAGE ENGINEERED TRUCKS

Kansas City 8, Missouri

SUBSIDIARY OF THE CARLISLE CORPORATION

D-136

In carrier landings, planes coming in at more than 100 knots are stopped in a split second. This amazing performance is made possible by having each plane hook onto one of several wire ropes stretched across the flight deck. Both plane and rope receive an almost unbelievable shock at the moment of contact. Needless to say, only top-quality wire ropes can be used for this application because . . .

you can't bargain with safety

While your use of wire rope differs from this carrier application, *safety should be just as important to you.* For, although a "bargain" rope may save you money, it can cost you your peace of mind. So don't bargain with safety. Buy a rope that's a *quality* rope—buy Wickwire Rope. 5049

WICKWIRE ROPE — A CF&I PRODUCT

CF&I

LOOK FOR THE YELLOW TRIANGLE

PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

THE COLORADO FUEL AND IRON CORPORATION—Denver • Houston • Odessa (Tex.) • Phoenix • Salt Lake City • Tulsa
PACIFIC COAST DIVISION—Los Angeles • Oakland • Portland • San Francisco • Seattle • Spokane
WICKWIRE SPENCER STEEL DIVISION—Boston • Buffalo • Chattanooga • Chicago • Detroit • Emeryville • New Orleans
New York • Philadelphia

Stockbridge replaces 8 trucks with 4 Macks

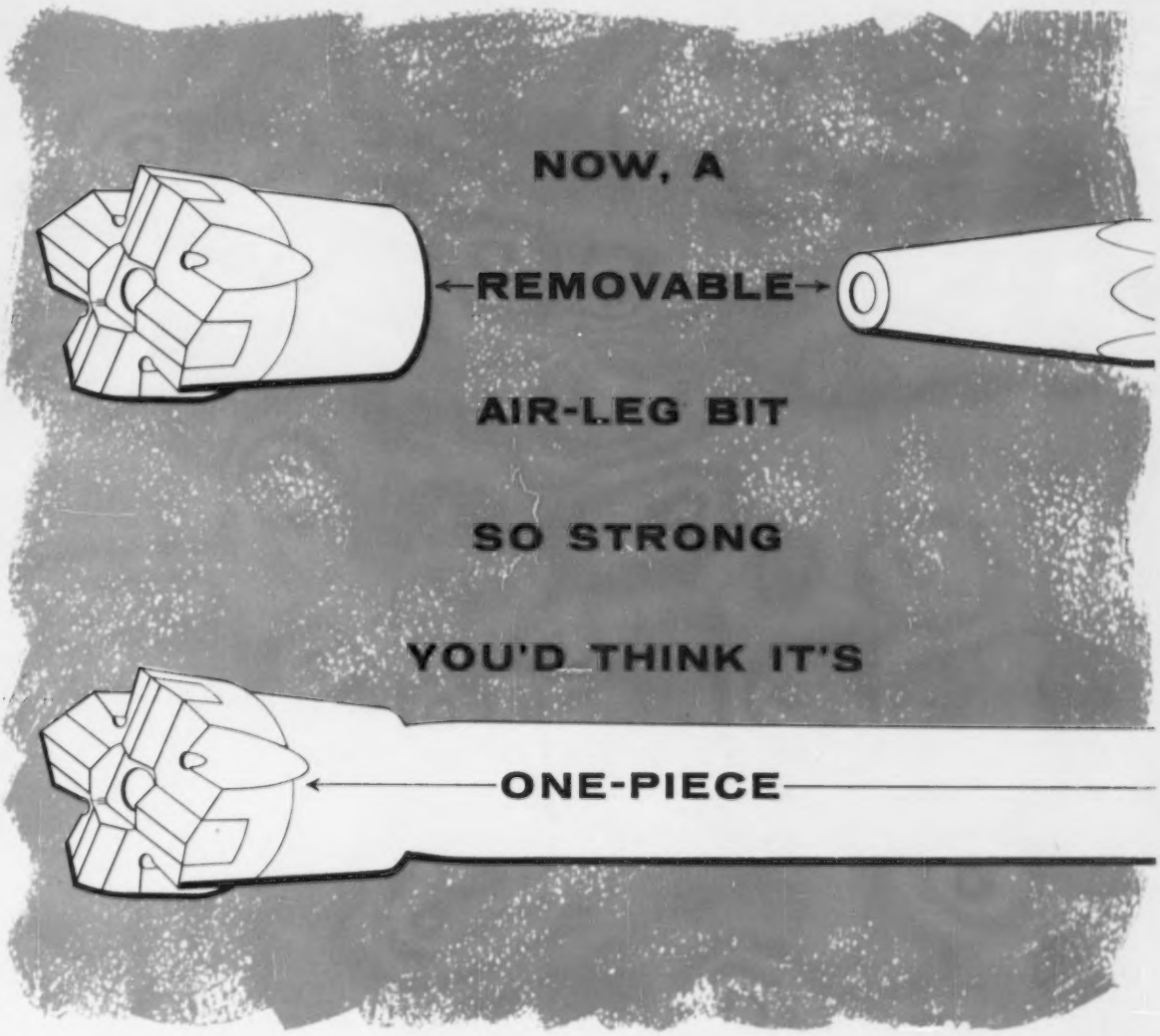
"We recently put four large-capacity Mack dumpers to work on a job that had required the full-time efforts of eight smaller trucks of competitive make. First result—four fewer drivers. Then—because of their capacity and agility—these big Mack LRVSW's spent less time spotting under the shovels and dumping at the crusher. Also, we have far fewer maintenance problems because Macks stand up better under the harsh working conditions," says Mr. Ray Lambert, vice president in charge of the Stockbridge Stone Company's Georgia operation.

"We are using 4½-yard electric shovels, and six to seven passes make an average load of about 34 tons. Our Macks easily shoulder these big payloads up the 12% grade from the quarry to the crusher, with the torque converter eliminating much of the shifting and absorbing most of the shock on the drive line. And with Mack's Balanced Bogie with Power Divider, our drivers have no worries about getting bogged down.

"To sum up our experience with Macks, we've found that you can't beat 'em for profit-making quality!"

Macks help to make a more profitable operation for Stockbridge. They will for you, too, whether your operation is quarrying or mining. Your nearest Mack representative will be glad to illustrate with on-the-job reports that prove the performance and durability of Macks. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd.

MACK
first name for
TRUCKS



THE new Timken® tapered socket bit for air-leg drills is removable —yet has the strength of one-piece steels. The tapered union gives you all the advantages of removability without the weaknesses that cause other removable bits to fail on air-legs.

Because the new Timken tapered socket bit is removable, you get all these advantages that intraset steels can't give:

You don't have to throw away the drill steel just because the carbides wear out. You do with intrasets.

You carry just a pocketful of bits into the mine. With intrasets you carry an armload of steel.

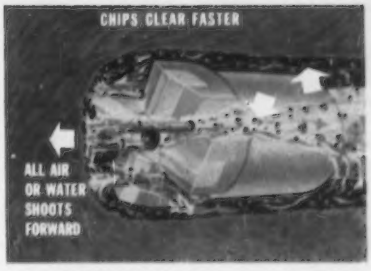
You can quickly change bit gauge sizes using the same steel. You have to change a whole steel with intrasets.

You don't have to lug the whole steel back to the shop to resharpen the cutting edges. You do with intrasets.

You get four carbide cutting edges, which insures longer gauge wear.

Two new frontal design features enable the Timken tapered bit to clear chips faster (see picture at right). And new special-analysis carbide inserts give superior wear-resistance with added shock-resistance. You can recondition them many times.

For removability *and* strength, use the new Timken tapered bit—the air-leg bit of the future. Write for free brochure. The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".



CHIPS CLEAR FASTER because 1) five front holes shoot water or air directly against the rock face and 2) deeper, wider wing clearance lets chips wash back faster.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

AVAILABLE NOW!

THE AIR-LEG BIT OF THE FUTURE

Attaching shielding ground wires to grounded messenger, workman completes joint in Anaconda 250 Mcm, 15,000 volt, grounded neutral, butyl-insulated, shielded, neoprene-jacketed cable in underground western mine.

What's this--Anaconda Aerial Cable underground?

Although the use of aerial cable underground sounds slightly incongruous, more and more mines are finding that it makes good sense. Good dollars and cents, too.

Cable is out of the way of damage by equipment, is easier to move, better for re-use. And there's no ditch to dig or fill. Simple installation, easy jointing and tapping reduce time and labor.

But there's more. Butyl insulation gives Anaconda mine power cable (aerial or otherwise) long-aging characteristics, improved resistance to moisture, ozone and heat. Neoprene jacket is rugged, tough – has real flexibility, resists rock cutting, impact, flame, sun and corrosive mine water.

Your Anaconda distributor has the facts and can help you choose the cable best suited to your needs. Call today! Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

67218

see the Man from ANACONDA®

for MINE POWER CABLE

IT'S A REAL ROCK DIGGER

Since they switched to a "Jimmy" Diesel

Want more work from *your* shovel? Then take a tip from T. B. Gatch and Sons, Inc., who operate a quarry near Churchville, Maryland.

They replaced the gasoline engine in this 1½-yard machine with a GM "6-71" Diesel a year ago. Results: 50% higher production. Two-thirds less fuel cost. Full capacity for work from half to full throttle. Less vibration and smoother operation that means longer life for boom, cables and other working parts. Says Senior Partner T. Ashby Gatch, "We can throttle the GM engine down and still retain ample power for the toughest rock digging. For boom swing we have the 'Jimmy's' quick acceleration, saving us time every cycle. There's no loafing on the job—this unit is now a real rock digger."

Taking tough jobs in stride is everyday work for GM Diesel-powered equipment. The 2-cycle "Jimmy" Diesel gives lightning response to power demands, operates on low-cost fuel and delivers years of dependable, trouble-free service. Specify GM Diesel when you order new equipment—ask your GM Diesel distributor about repowering old machines.

DETROIT DIESEL Engine Division of General Motors, Detroit 28, Michigan

GM GENERAL MOTORS DETROIT DIESEL POWER

Regional Offices: New York, Atlanta, Detroit, Chicago Dallas, San Francisco

In Canada: GENERAL MOTORS DIESEL LIMITED, London, Ontario

Now—more than ever—it pays to standardize on GM Diesel—available in 1485 applications of power equipment built by more than 175 manufacturers

Parts and Service Worldwide

A GM "6-71" Diesel powers Northwest 1½-yd. shovel operating in quarry of T. B. Gatch and Sons, Inc., Baltimore, Md.

reduce time and labor.

But there's more. Butyl insula-

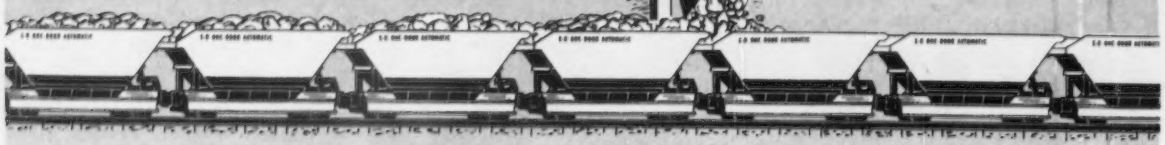
for MINE POWER CABLE

Why in the world didn't we think of this before?

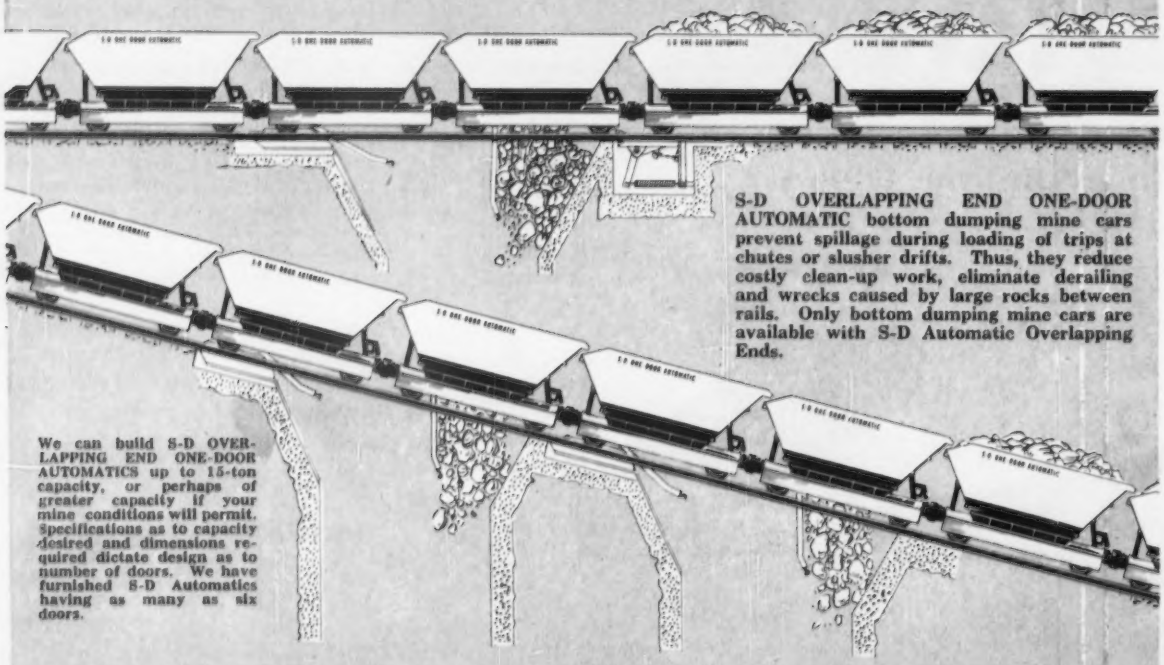
By combining our overlapping end design for bottom dumping mine cars and our one-door bottom dumping car design, our engineers have developed the S-D OVERLAPPING END ONE-DOOR AUTOMATIC, for years needed in the metal field because it offers:

- GREATER CAPACITY FOR SAME OVER-ALL DIMENSIONS
- BETTER TRACKABILITY
- LOW CENTER OF GRAVITY

- WIDE DOOR OPENING
- CLEAN SHEDDING
- SIMPLE and LOW COST DUMP FACILITY
- RUGGEDNESS OF DESIGN



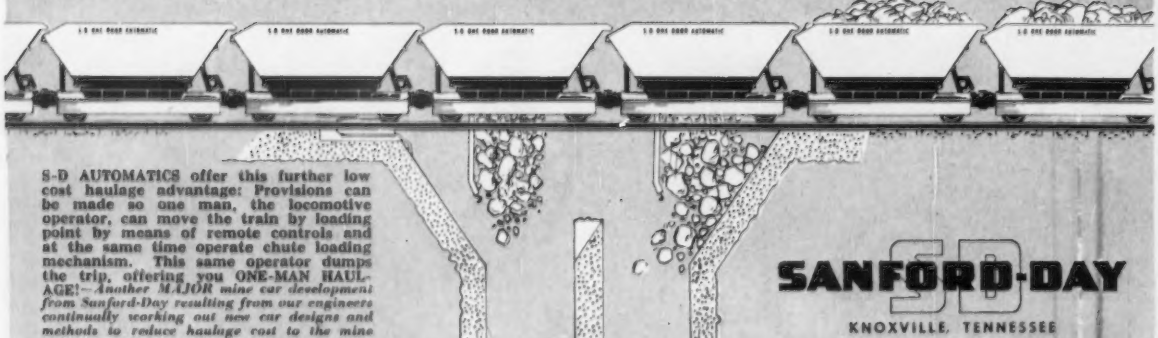
S-D AUTOMATICS with OVERLAPPING ENDS PREVENT SPILLAGE!



S-D OVERLAPPING END ONE-DOOR AUTOMATIC bottom dumping mine cars prevent spillage during loading of trips at chutes or slusher drifts. Thus, they reduce costly clean-up work, eliminate derailing and wrecks caused by large rocks between rails. Only bottom dumping mine cars are available with S-D Automatic Overlapping Ends.

We can build S-D OVERLAPPING END ONE-DOOR AUTOMATICS up to 15-ton capacity, or perhaps of greater capacity if your mine conditions will permit. Specifications as to capacity desired and dimensions required dictate design as to number of doors. We have furnished S-D Automatics having as many as six doors.

DUMP FAST, THOROUGHLY into any type underground bin you have!



S-D AUTOMATICS offer this further low cost haulage advantage: Provisions can be made so one man, the locomotive operator, can move the train by loading point by means of remote controls and at the same time operate chute loading mechanism. This same operator dumps the trip, offering you ONE-MAN HAULAGE! — *Another MAJOR mine car development from Sanford-Day resulting from our engineers continually working out new car designs and methods to reduce haulage cost to the mine industry.* Write or call us today. *Sanford-Day Iron Works, Inc., Knoxville, Tenn. U.S.A.*

SANFORD-DAY

KNOXVILLE, TENNESSEE

"SUPER MARKET FOR MINE CARS" — all types ★ PRECISION WHEELS ★ "BROWNIE" HOISTS, CAR RETARDERS, SPOTTERS, PUMPS AND OIL SPRAY SYSTEMS ★ GISMO SELF-LOADING TRANSPORT that loads (mucks) in development or production . . . transports . . . supports 2 to 5 jib mounted drills . . . back fills . . . moves boulder rocks . . . makes its own roadways and cleans up completely — a new method of hard-rock mining offering a tremendous reduction in cost per ton!

CERTIFIED OWNER REPORT

Carbon County's 1½-cu. yd. TerraTrac loads three 5-yd. trucks in 6 minutes — *handles over 1000 cu. yds. of gravel a day, without tearing up pit floor, as former machines did.*

How Carbon County, Montana...increased pit efficiency 30% by replacing two machines with one Case® TerraTrac® "800"

Carbon County, Montana, scenic northeastern gateway to Yellowstone National Park, recently *replaced a bulldozer and expensive dragline* with ONE fast-moving 1½-yd. Case TerraTrac Model 800 tractor-shovel. *Result:* pit production was increased 30%, with greatly reduced investment.

According to *Edgar Gruel,* County Commissioner of Montana District 2, in Joliet, "We liked the price and advanced features of the 80 HP diesel-powered TerraTrac. But, being a new machine, we wondered if it would deliver the goods. Now, after 3 months' operation, we've found it *does more jobs, and does them better than we even expected.* It has already moved 11,000 yds. of material in 150 hours, with no noticeable wear."

"Best machine I've ever operated"

Veteran county operator, *Charles Shandy,* who has spent over 33,000 hours on all types of crawler rigs, adds: "This is the best crawler-loader for its size I've ever run. With torque converter, power steering and instant power-shift, *I can do twice as much work without feeling nearly as tired as I used to* get on clutch-and-shift-type machines."

Carbon County has also discovered that TerraTrac's *exclusive* "counter-rotating" transmission, which permits smooth spin-turns — with both tracks driving in opposite directions *— keeps the floor of their pits in better condition for loading.* Says Shandy, "We've used the TerraTrac in 4 different pits and find that, regardless of floor level, it does not tear up the floor materials, as former machines did."

Handles variety of jobs

Besides speeding gravel-loading, Carbon County's 1½-yd. TerraTrac is kept busy loading *3200 to 3800-lb. rim-rock boulders,* for rip-rapping river banks... digging-out, cleaning and replacing steel culverts... digging cattle crossings ...and handling general road-maintenance work. *"We formerly had to haul out two or three machines to do these jobs — now we handle everything with one TerraTrac '800',"* says *Commissioner Gruel.*

Why not name a date and let your Case Industrial Dealer demonstrate this faster, easier-handling crawler (or the larger 100 HP, 2-cu. yd. model) on *your* jobs—REAL SOON!

CASE

1st in quality for over 100 years

INDUSTRIAL WHEEL and CRAWLER TRACTORS • LOADERS • DOZERS • BACKHOES • ENGINES

Clip...mail for free catalog

J. I. CASE COMPANY, Dept. M1377, Racine, Wis., U.S.A.

☐ Send free catalog on 1½ and 2-cu. yd. Case TerraTrac Tractor-Shovels

☐ Send name of nearest Case Industrial Dealer

Name ..... Title.....

Organization .....

Address .....

City ..... State.....

CT-L-116

Roebling Royal Blue Wire Rope goes to any length to prove its **high strength!**

Every inch of every foot of Royal Blue is stronger than any rope you've ever used on *any* job. This on-the-job tenacity helps to make it the most widely and readily accepted rope in Roebling's history. It is but one of Royal Blue qualities that makes for its long service life—on any job you choose. For full details on Roebling Royal Blue Wire Rope talk to your distributor or write to Wire Rope Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey, for your copy of "*Wire Rope Recommendations and Catalog*."

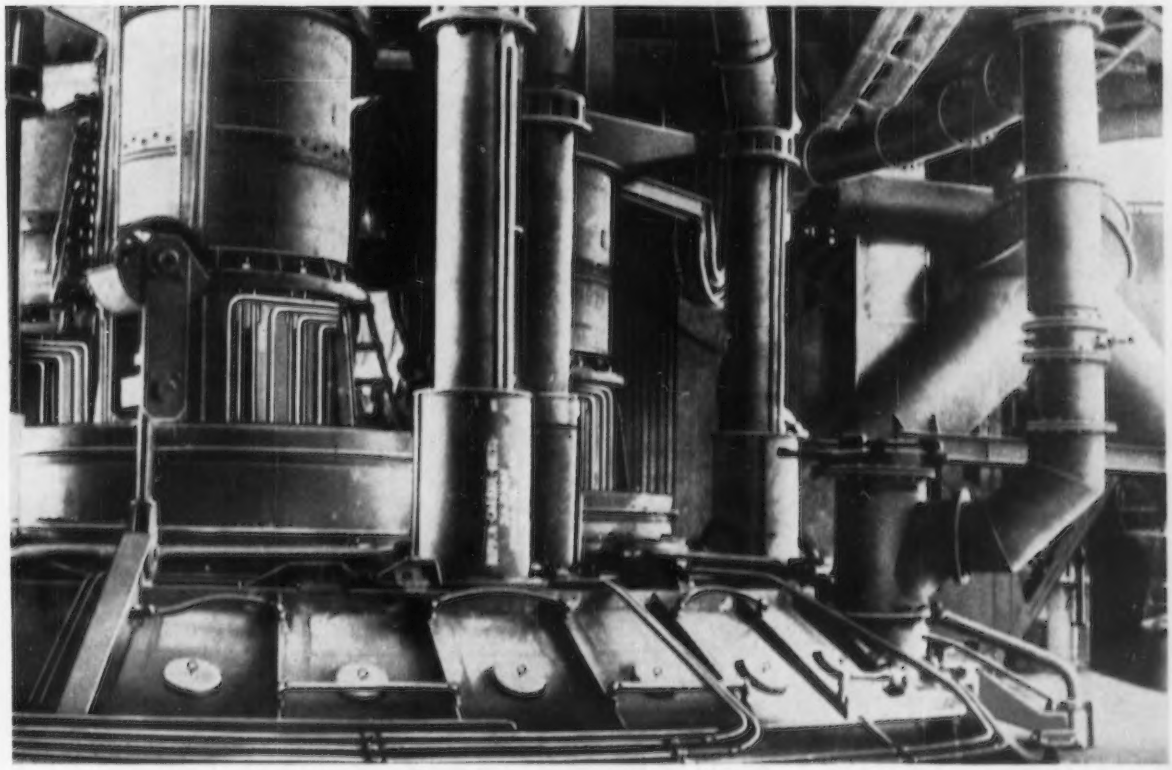
ROEBLING

Branch Offices in Principal Cities—Subsidiary of The Colorado Fuel and Iron Corporation

City ..... State.....
CT-L-116

98% gas recovery
from completely covered, sealed-so-tight

DEMAG ELECTRIC SMELTING FURNACES



THE *first* completely covered, tightly sealed smelting furnaces were developed by Demag . . . and the Demag design has *never been surpassed!*

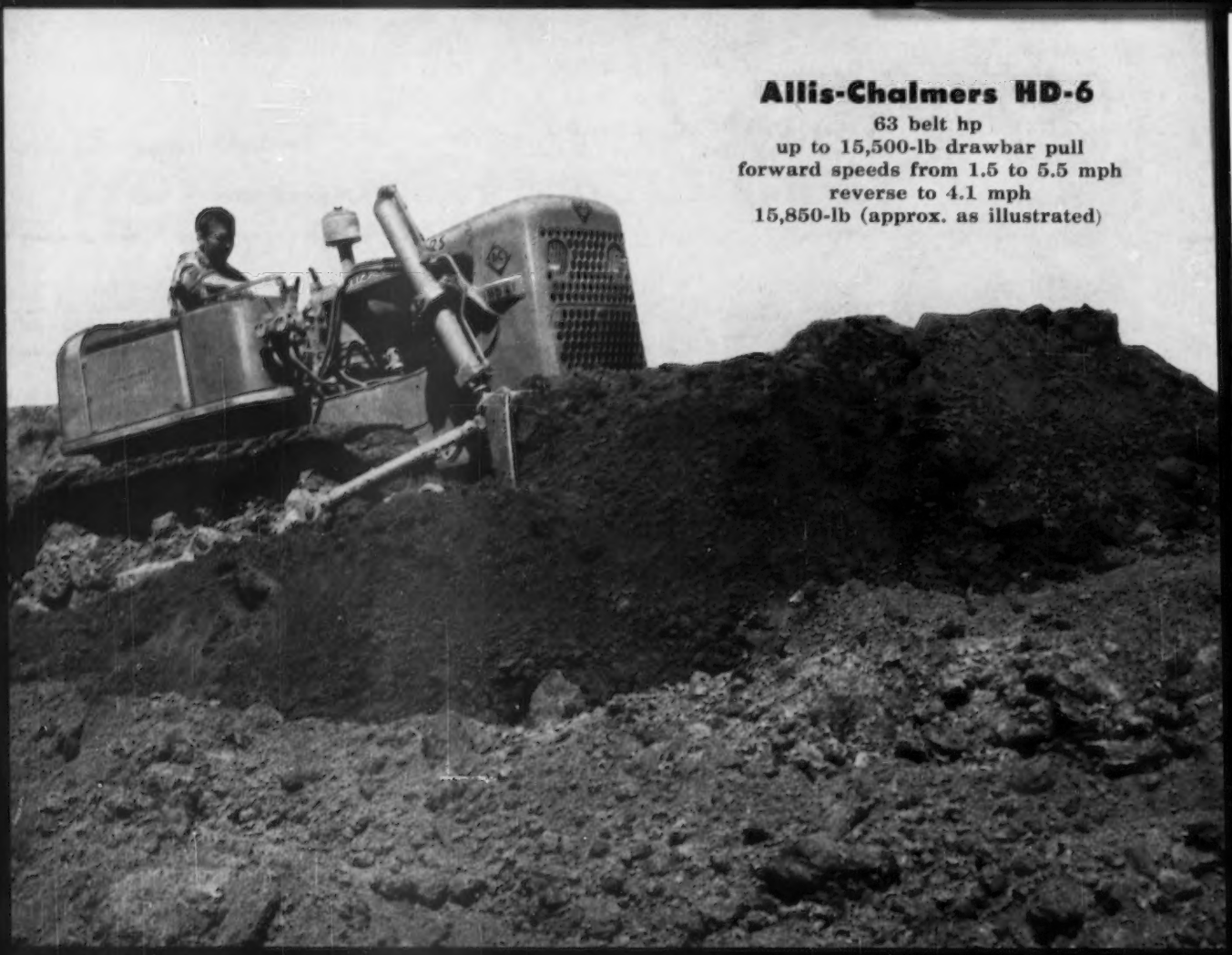
Gas-tight passage of movable electrodes through the roof forms a friction-free seal . . . so effective that 98% of valuable furnace gases are recovered. Roof lifting gear makes start-ups and inspection of interior furnace conditions easier. Retractable feed chutes regulate mix level of charge . . . furnace operates as efficiently at reduced as at full loading.

And now these and many other exclusive advantages of Demag design are available from Lectromelt . . . America's outstanding producer of electric furnaces. This unmatched Lectromelt-Demag combination of skills affords way-ahead efficiency, economy and safety in electric smelting furnaces.

For help in meeting any furnace requirement, contact Lectromelt Furnace Division, McGraw-Edison Company, 322 32nd Street, Pittsburgh 30, Pennsylvania.

Lectromelt*

*Reg. TM U.S. Pat. Off.



Allis-Chalmers HD-6
63 belt hp
up to 15,500-lb drawbar pull
forward speeds from 1.5 to 5.5 mph
reverse to 4.1 mph
15,850-lb (approx. as illustrated)

MORE DRAWBAR PULL . . . BETTER DOZING SPEEDS EASIER HANDLING . . .

. . . *than anything near its size*

More drawbar pull for extra output . . . up to 44 percent more drawbar pull enables the HD-6 to handle tougher jobs — bigger loads than other crawler tractors in its size.

Better dozing speeds . . . five forward speeds — including a 1.5 dozing gear as standard equipment — provide the right combination of power and speed for better dozing and higher production.

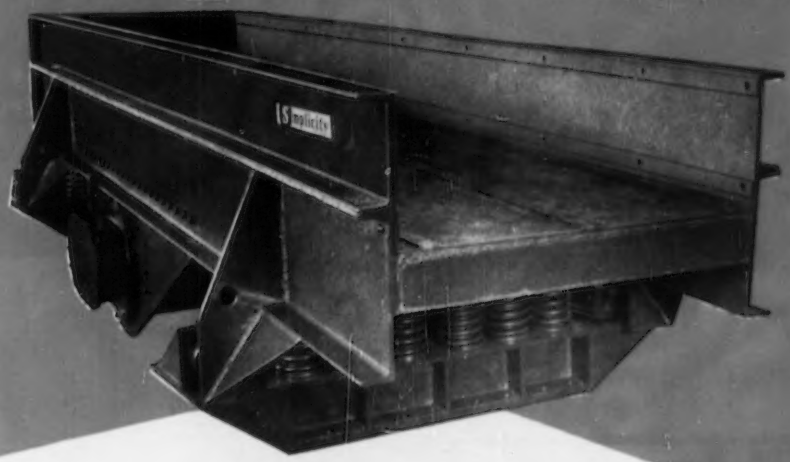
Easier handling . . . owners and operators of an HD-6 like its easy-to-reach controls, low lever pull clutches, direct electric starting and convenient rotary-valve dozer control.

Ask your Allis-Chalmers construction machinery dealer to demonstrate the HD-6 on your job. You'll agree that the HD-6 is the best tractor-dozer in its size. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

VIBRATING PAN IS THE ANSWER!

Simplicity OS-A-VEYOR feeders lower maintenance and increase operating efficiency . . . LIMESTONE to TACONITE ORE



These Simplicity vibrating pan type feeders have proven themselves throughout the mining and quarry industry. They are not only handling various types of stone and aggregate, but the extremely abrasive taconite ore.

Lower maintenance costs have been proven by long experience in the field. The simplicity of the pan construction allows the unit to be easily repaired with existing materials. These feeders are available with replaceable liners of abrasion resistant steel. The oscillating action is provided by two eccentric shafts coupled to a single V-belt drive . . . leaving only one assembly and four bearings to lubricate.

The Simplicity Os-A-Veyor feeders are self-cleaning units. They experience none of the return spillage found in apron feeders. The Os-A-Veyor feeder will discharge material with a minimum fall, the height of drop is not determined by the size of a sprocket. The units are designed to handle heavy column loads. Overloading the feeders causes no damage, as there is no mechanical connection between the eccentric drive and the main frame or bin.

The Simplicity Os-A-Veyor feeders are main frame supported, or can be supported from the bin with spring and cable suspension, eliminating the need for separate concrete foundation. Sizes available range from 1′ x 4′ to 6′ x 20′ with capacities to 1000 tons per hour.

169

If you wish further information on Simplicity Os-A-Veyor feeders, grizzly feeders, horizontal screens or gyrating screens write . . .

SALES REPRESENTATIVES IN ALL PARTS OF THE U.S.A.

FOR CANADA: Simplicity Materials Handling Limited, Guelph, Ontario

FOR EXPORT: Brown and Sims, 50 Church St., New York 7, N. Y.

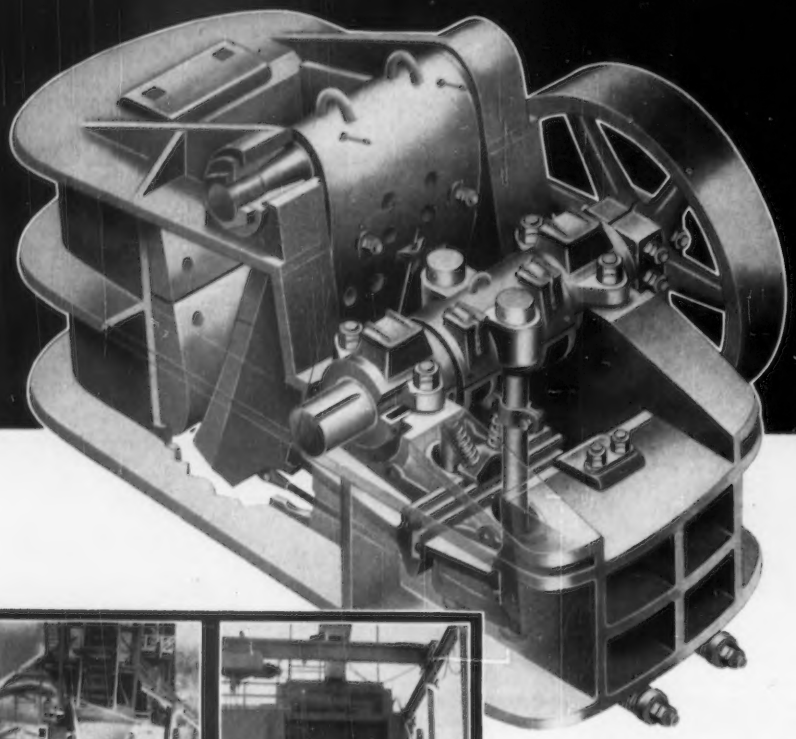
Simplicity

TRADE MARK REGISTERED

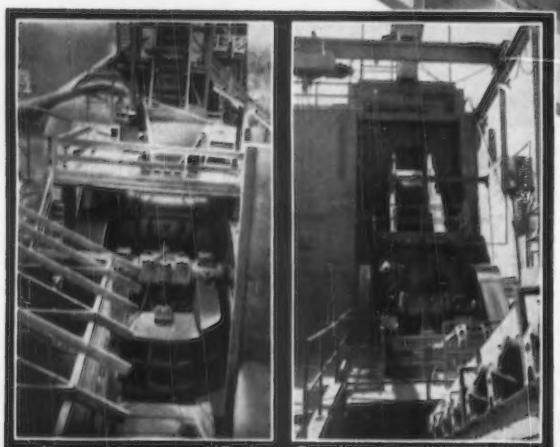
ENGINEERING COMPANY • DURAND 4, MICHIGAN

TRAYLOR-MADE

is engineering craftsmanship



Type HB
Jaw Crusher



48" x 60" type HB Jaw Crusher in primary service, reducing quarry material to desired size.

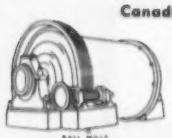
Cutaway view of the type HB Jaw Crusher shows the advance design characteristics of Traylor-Made Jaw Crushers—notice the sturdy bulldog pitman. One of the many important features of this crusher is the Traylor curved jaw plate. This design employs the principal of the famous curved fittings which have proved so successful and satisfactory in Traylor crushing machinery. Write for Bulletin #5105 for information.

TRAYLOR ENGINEERING & MFG. CO. 1921 MILL ST., ALLENTOWN, PA.

Sales Offices: New York — Chicago — San Francisco

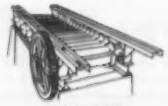
Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P. Q.

Traylor



BALL MILLS

ROTARY KILNS



APRON FEEDERS

PRIMARY GYRATORY CRUSHERS

JAW CRUSHERS

SECONDARY GYRATORY CRUSHERS

CYCOLAC®

production by Marbon

plant by CATALYTIC

®Registered trade-mark for an ABS Polymer for the MARBON CHEMICAL DIVISION of Borg-Warner Corporation

To meet the growing demand for CYCOLAC, its new high impact strength plastic, MARBON CHEMICAL DIVISION, Borg-Warner Corporation chose Catalytic to engineer, design and construct a unique new production facility.

Within Catalytic creative, versatile minds united modern process ideas, skilled engineering, and construction know-how to build this new plant—on time and on budget.

Catalytic's broad and diversified experience in chemicals, petroleum, petrochemicals, and metallurgy stands ready to help you create better and more profitable plants for tomorrow.

CATALYTIC
Construction Company

Philadelphia 2, Pennsylvania
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In Canada: Catalytic Construction of Canada, Limited; Sarnia, Ontario; Toronto, Ontario; Montreal, Quebec

Catalytic *On-Time... On-Budget* Services

for the metallurgical, chemical, petrochemical and oil refining industries: Project Analysis; Process Development; Process Design; Economic Studies; Engineering; Procurement; Construction.

MEDIUM IN SIZE . . . LARGE IN CAPACITY
A NEW CONTINUOUS-RATED SLUSHER FROM JOY

The C2F-211A is a *new* kind of slusher. It is the size of a medium capacity machine . . . compact and portable enough to move from place to place in the mine. Yet, it approaches large capacity slushers in load lugging ability and hour-after-hour stamina.

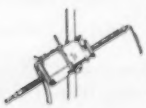
To meet extra-heavy digging requirements this newest Joy slusher is powered by a 50, 60, or 75 HP high-torque, high slip, flange-mounted motor. The high torque developed pulls the scraper through the pile without stalling. By eliminating repeated stalling and starting, fewer shock loads are imposed on the machine. Other features, such as *three* idler gears in each drum's planetary system provide 50% greater capacity.

Depending on motor horsepower and rope pull desired, rope speeds range from 165 to 350 feet per minute. Find out more about the C2F-211A, the new medium-sized slusher that hauls the bigger scraper loads. Write **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

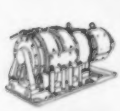
WSW M 6703-183

WRITE FOR FREE BULLETIN 183-4

JOY . . . EQUIPMENT FOR MINING . . . FOR ALL INDUSTRY



Core Drills



Slushers

Rock Bits

Trackless Equipment

View of ore bank before final cleaning of face prior to shot.

Loading "Nitramex" 2H in bore hole. 9" x 18" unit weighs 73.5 lbs.

Pouring Pelletol No. 1 into hole to fill annular space around column. The combination of "Nitramex" 2H and Pelletol No. 1 gives the highest possible concentration of energy at the bottom of the hole where it is needed to break this very hard ore.

Du Pont "Nitramex" 2H in action. Using this very high density blasting agent helped Jones and Laughlin overcome a tough shooting problem with maximum safety.

Ore bank after the shot. Note the excellent breakage produced by "Nitramex" 2H.

High density of Du Pont "Nitramex"® 2H solves tough shooting problem

Blasting magnetite is always a problem, but at the Jones and Laughlin Steel Corporation open pit at Star Lake, New York, they found that Du Pont "Nitramex" 2H does a better job of breaking bottom than any material they have used.

"Nitramex" 2H has a density of 1.80—provides a far higher concentration of energy per foot of bore hole than any other blasting agent or commercial explosive.

Because "Nitramex" 2H has infinite water resistance, it can be loaded in wet holes as long as necessary before shooting.

For more information on "Nitramex" 2H, contact your Du Pont representative or write E. I. du Pont de Nemours & Co. (Inc.), Explosives Department, Wilmington 98, Delaware.

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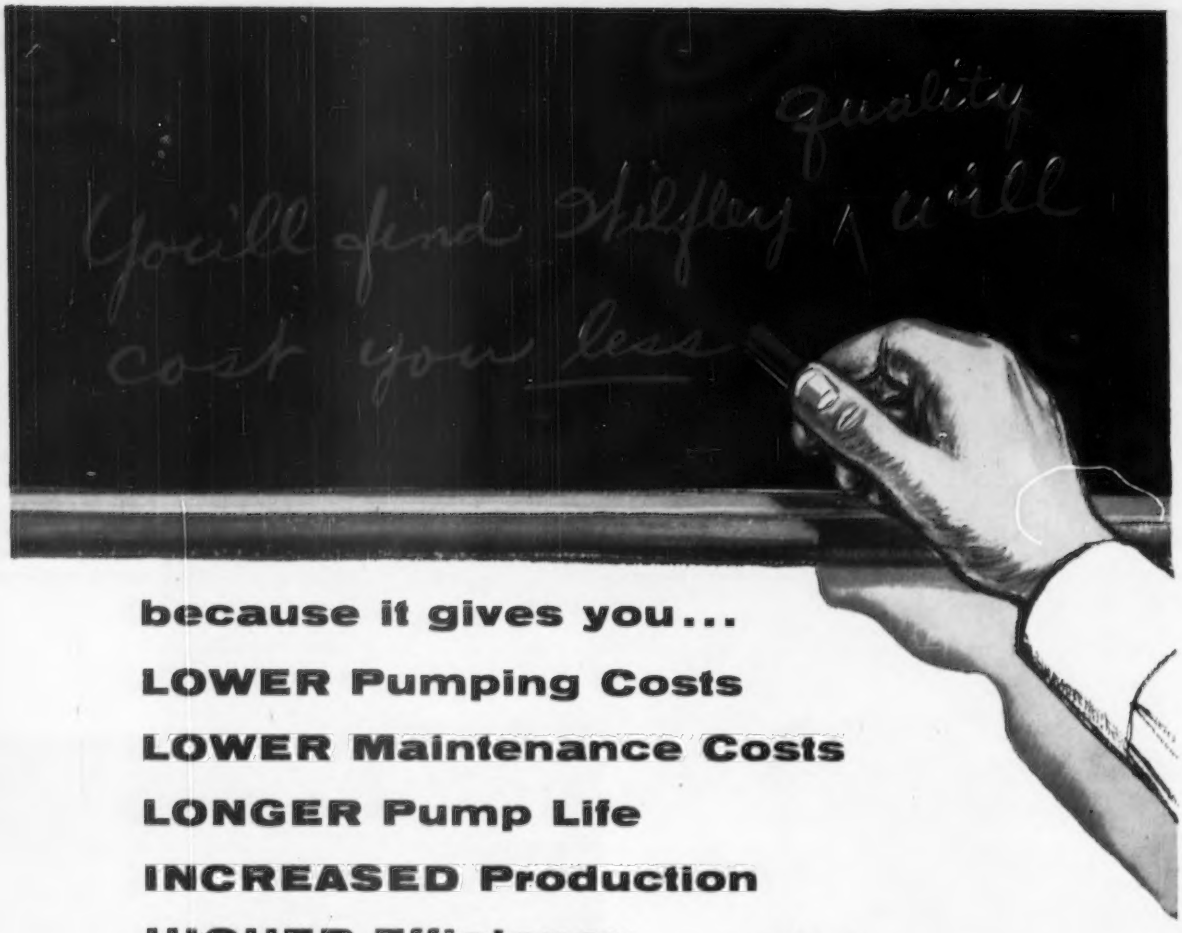

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LONGER Pump Life

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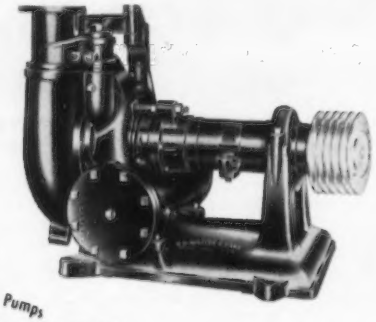
When you buy quality, Wilfley quality, you buy *superior* performance. You start *saving* money the moment a Wilfley Sand Pump goes into action. Let Wilfley solve your pumping problem. Write, wire or phone.



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ENGINEERING AND MINING JOURNAL

DECEMBER, 1957

What We Can Learn From 1957's Price Slump

THREE TIMES since Government price controls were removed from copper, lead and zinc in mid-1946, and metals moved into some semblance of a free market, the mining industry has undergone distress due to sagging markets and prices. The violent price swings have been international in character, and consumers in industrial countries all over the world have smarted under the numerous shifts in price and supply.

So, as 1957 draws to a close and we find ourselves in another temporary period of depressed metal markets, we might well ask ourselves if there isn't something which we can do to prevent these cyclic swings that irritate consumers and run the small but necessary high-cost producer in and out of business.

First we have to admit that unpredictable factors, such as prolonged strikes, shipping strikes, low consumer inventories brought about by poor market forecasting by manufacturers, poorly-timed Government stockpile buying, and sales of surplus metals in the world market by government agencies all aggravate the market.

Admittedly, such elements are beyond the control of metal producers. However, there are some basic corrective measures that domestic and international mining companies can take to moderate the fluctuations in metal markets. These measures involve a degree of industrial self-discipline and moderation which might be difficult to adopt, and still harder to sell to company stockholders. Nevertheless, some internationally-recognized mining men, well known for their prudent attitude toward markets, such as Sir Ronald Prain, chairman of Rhodesian Selection Trust, have had courage to voice corrective measures.

In effect, Sir Ronald has suggested that copper producers of the world cut back production by about 10% to alleviate mine shut-downs and labor layoffs, and bring about a better balance in the copper market. (See *E&MJ*, October 1957, p 68).

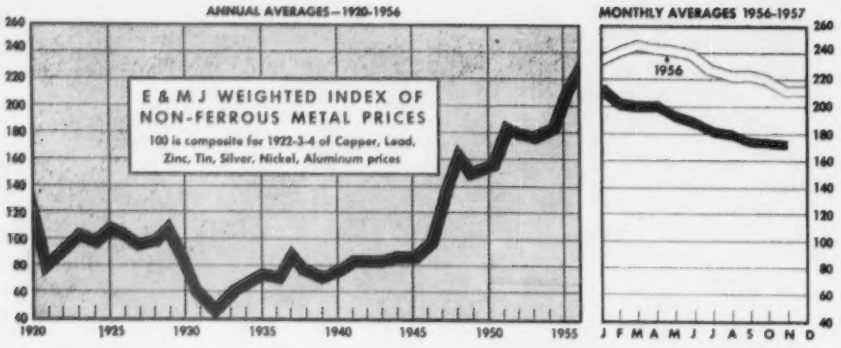
A study of price charts for copper, lead and zinc on p 75 clearly shows that persistently increasing stocks may signal a price drop. If we add to the accumulating stocks the amounts of metal which have gone to stockpile (see inferred monthly diversions for lead and zinc), it's quite plain that the non-ferrous metals industry was heading for the same kind of trouble many months ago that it encountered during the 1952-53 slump.

It's also obvious that the U.S. Government wouldn't tolerate concerted action of domestic metal producers to control markets. However, there's nothing to prevent mines everywhere from shifting substantial effort from production to exploration, development and pit stripping when metal markets show definite signs of weakening. This idea is not novel in the mining industry. The steel industry traditionally runs at less than capacity when markets are weak and the price history of the industry shows the wisdom of the policy.

Now, if we study the simple economic equation: *Production = Demand*, we find that there are ways to stimulate demand. One way is to spend a substantial percentage of the gross intake for research and new product development. A successful aluminum company has spent as much as 10 to 12% of its gross in the broad area of research and new product development. Another successful nonmetallic mineral producer spends about 3% for research and product development and finds the expenditure profitable. It is also encouraging to note that the lead, zinc, copper and brass industries are accelerating their efforts in the direction of developing new uses for metals.

E&MJ OUTLOOK

PRICES



MARKETS

E&MJ's metal price index slipped from 176.22 for October to 175.46 for November. Lower lead, silver and tin prices contributed to the drop.

●

AT HOME

Market for steel in the seven Western States is expected to approach 7-million net tons this year, according to a Kaiser Steel Co. report. More than half of this total is provided by Western mills.

National Lead Co. has developed a new alkaline uranium leaching circuit which reduces leaching time from two days to 80 min. Key to the new method is oxidation of low-valency uranium with air in presence of ammonia and copper sulphate.

Merger of American Metal Co. and Climax Molybdenum Co. would broaden the diversification of the combined companies to include copper, lead, zinc, precious metals, uranium, vanadium, by-product tungsten, potash, and oil and gas.

American Metal Co. reveals the discovery of a new copper deposit in Upper Peninsula of Michigan estimated to contain about 50,600,000 tons of copper-bearing shale (average copper content 1.52%) and an additional 54,400,000 tons of lower grade shale (average copper content 1.04%).

Westinghouse Electric Co. awarded Firth Sterling, Inc., a $1.5-million contract for production of zirconium mill products. Oregon Metallurgical Corp., Albany, Ore., received a contract to deliver approximately $4-million worth of zirconium metal to Westinghouse during the next 12 months.

Wyoming's Supreme Court has ruled that radiation-counter readings are insufficient proof of discovery of uranium on lode mining claims.

●

LABOR

Mounting unemployment is expected to weaken the bargaining position of unions in next year's negotiations. Walter Reuther is bringing the shorter week into future negotiations on a share-the-work week basis. See p 123.

●

ABROAD

Glycon de Paiva, former chief of Brazil's Development Bank was elected president of Kaiser Aluminum International. This appointment is expected to signal development of Guiana bauxite extensions in the Amazon Valley.

Tin Research Institute, London, announces a new aluminum-tin bearing-alloy containing 20% tin and the balance aluminum. About ½-million bearings containing the alloy have been manufactured.

A herd of 15,000 buffalo is preventing geologists from exploring Northern Manitoba's 17,300-square-mile Wood Buffalo Park which is believed to contain potential lead-zinc deposits. Canada's Commission of Northern Development scheduled hearings to find out what the geologists are looking for, and, if necessary, may "shoo the buffalo over a few miles."

MARKETS

Custom Smelters Drop Copper to 25c. Lead Sales Low. Tariff Hearings End.

THE *E&MJ* WEIGHTED NONFERROUS METAL PRICE INDEX for November dropped to 175.46% of the 1922-24 average, from 176.22% in October. The drop reflected lower prices for tin, silver and lead.

Monthly average copper prices changed little in the U.S. and abroad in November. U.S. custom smelters for the most part were selling at 25½¢ at the beginning of November. Early in the month some raised to 26¢; at least one seemed hesitant to follow but finally did. It indicated at the time no faith in the 26¢ price. In a few days none was being sold at over 25½¢ and late in the month none was going for more than 25¢.

Early in the month London rose to over £190—about 23¾¢—and the more hopeful suggested "the turn-around" was here. The more analytical demurred. Katanga raised to 24½¢, Europe and U.S., early in November. But it then started reducing: Nov. 19 it was at 23.8¢ and on Nov. 28 it had dropped to 23.15¢.

With the 2¢ spread between the U.S. producers and the U.S. custom smelters, some began to wonder if the 27¢ price would hold. Perhaps more instrumental in this situation is the foreign copper product inflow into the U.S. At the 27¢ base it is difficult for U.S. fabricators to meet European fabricated product price competition; the large U.S. integrated producers can hardly reduce their fabricated product prices enough to meet this without also reducing by as much the price at which they sell refined copper. Recently, U.S. fabricators raised the margin for fabricated products over the refined copper to cover rising labor and other costs. This move, insofar as it is not offset by price shading, makes competition with foreign products more difficult.

In Europe, discussions are being held in which 5-year contracts, in some cases priced on the LME, and in some on other bases, are being considered. Some proposals are that they be terminable on 90 days' notice.

U.S. Tariff Commission hearings ended Nov. 27. The first few days of the hearings proponents indicated many lead and zinc mines in the U.S. were closed owing to low prices; they attributed this to heavy imports. Most asked for maximum tariff increases (see *E&MJ* October 1957, p 69). The last few days of the hearings consumers and importers attacked the proposals vigorously. U.S. smelters emphasized the need for a wider spread between metal import duties and ore import duties. Many expect the Commission to recommend the maximum increases on metal—but less than the maximum on ores.

Lead sales in November were unusually low. Dec. 2 a leading smelter dropped its price ½¢, to 13¢ N.Y. Doubtless some consumers think domestic stockpile buying will end as soon as higher tariffs are instituted (implied in a remark of ODM director Gray last month) and therefore there may be no net price increase. Some analysts believe when the tariff rises occur the price will also go up but that it will drop back almost immediately. Many expect the difference beween the U.S. price and London's to be about 4¢ or a little more.

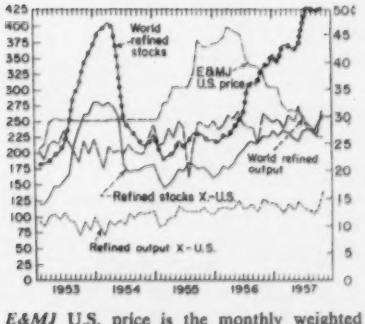
Zinc sales in November were not good though they improved during the last week. GSA asked for tenders of lead and zinc for delivery by mid-January. Some think it will enter the market only once more. The U.K. government's Board of Trade offered 8,881 tons of zinc for sale from its stockpile; it has about that amount yet to sell. There has been no general deduction in the U.S. Special High premium of 1.75¢ a lb, though many makers of zinc die-casting alloys say they must get ½¢ off this to compete with integrated producers of the alloys. There have been sales at ½¢ off.

Aluminum will be in oversupply for several years, according to the president of Aluminium Ltd. Russian aluminum is available in Europe at 23¢ delivered. U.S. primary producers' minimum bid on European business has been about 23½¢ delivered European ports. Norway has sold at less.

Quicksilver prices continued to drop. They are now at the $225 U.S. Government buying price. When the program was set up a few years ago, the Government specified a flask that would guarantee no leakage in storage—it had lost much from storing in standard flasks. Sellers apparently forgot these specifications until a month or two ago when they were considering selling to the Government. They discovered the flask would cost $8 or more. They kicked. The Government then arranged a new specification for a flask that will cost about $4.35. It also said the termination date for the first section of the program would be extended until Mar. 31, 1958, for mercury tendered by Dec. 31, 1957, the original shipping termination date.

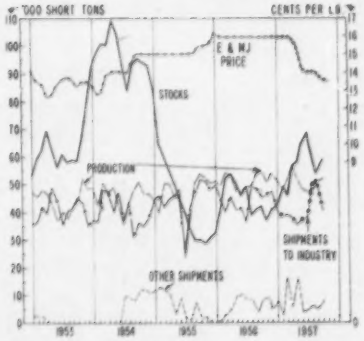
FOR MINING EXECUTIVES concerned with day-to-day changes in metal and ore prices and authoritative interpretation of metal market trends and developments, *E&MJ* publishes a weekly market information service, *E&MJ METAL AND MINERAL MARKETS*. More details and a handy order form will be found in the advertisement on page 40 of this issue.

Copper Data



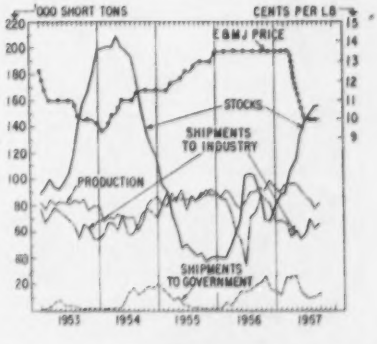
E&MJ U.S. price is the monthly weighted average for domestic copper, in cents per lb. Other data are from the Copper Institute and are in thousands of short tons. They include October 1957. The two series "X-U. S." are the world producer statistics less the U. S. No. fabricator stocks are included.

Primary Refined Lead Data



Data, except price, from the American Bureau of Metal Statistics. "Other Shipments" refers to shipments to the U. S. Government. The price is the *E&MJ* weighted average, N. Y. Data through October. Price through November.

U. S. Slab Zinc



Data, except price, from American Zinc Institute. They refer to slab zinc from all U. S. primary and secondary smelters. Output from foreign ores included. Price is the *E&MJ* weighted average St. Louis price. October the last month reported.

MARKETS (*Continued*)

Average Prices Nov. (E&MJ Quotations)

Copper:	
Electrolytic, domestic refinery	26.339
Electrolytic, export refinery	23.109
Lead:	
Common, New York	13.500
Common, St. Louis	13.300
Silver and sterling exchange:	
Silver, New York, per oz.	90.368
Silver, London, pence per oz.	78.173
Sterling Exchange	280.261
Zinc:	
Prime Western, East St. Louis	10.000
Prime, Western, delivered (g)	10.500
Tin:	
New York Straits	89.359
Gold per oz. U. S. price	$35.000
Quicksilver, per flask	$226.957
Antimony, (E&MJ) (d)	36.590
Antimony, bulk, Laredo	33.000
Antimony, in cases, Laredo	33.500
Platinum, refined, per oz.	$84.000
Cadmium (a)	170.000
Cadmium (b)	170.000
Cadmium (c)	170.000
Aluminum, 99% plus ingot	28.100
Magnesium, ingot	35.250
Nickel (f)	74.000

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.

(a) Cadmium average based on the producers' quotations.

(b) Cadmium average based on the average of the producers' and platers' quotations.

(c) Cadmium average based on platers' quotation.

(d) Domestic, 5 tons or more but less than carload lots, packed in case f.o.b. New York.

(f) Contract price, f.o.b. Port Colborne, U.S. duty included. Other regular sellers 78¼c to $1.25.

(g) Delivered where freight exceeds 0.5c.

"Free" Gold Market

Volume increased 75%. Soviet gold sales in Europe swelled total sales to their highest monthly level of the post-war period. Continental transactions were led by London where the month's turnovers reached $50-million. Asiatic markets were active with Beirut, Bombay and Bangkok leading. Coin dealings increased in Rio. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	COINS		BARS (12.5 kg)	
	Oct. 31	Nov. 30	Oct. 31	Nov. 30
NEW YORK, transit	.....	.....	$35.08⅛	$35.08⅛
MANILA	$44.25	$44.00	36.50	36.50
HONG KONG	46.25	45.75	38.45	38.25
BOMBAY	58.00	58.25	57.25	57.50
TANGIER	42.50	42.25	34.98	34.94
BEIRUT	43.20	43.20	35.15	35.10
PARIS	44.00	43.90	36.45	36.45
BUENOS AIRES	39.50	38.50	36.45	36.00

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Custom Smelter Copper Price

Based on flat price and E&MJ-average price sales in U. S. for month of November reported by American Smelting & Refining Co.: electrolytic copper in standard shapes, adjusted to nearest 1/16c; ¼c deducted for selling commission.

Delivered Consumers' plants	25.250c lb
F.o.b. refinery	24.850c lb

Major Metals

U. S. DAILY AND AVERAGE PRICES

Nov. 1957	Electrolytic Copper (a) Domestic	Electrolytic Copper (b) Export	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99%	Straits Tin New York
1	26.175	23.475	13.500	13.300	10.500	10.000	26.000	90.375
2	No Market	23.475	13.500	13.300	10.500	10.000	26.000	90.375
4	26.125	23.325	13.500	13.300	10.500	10.000	26.000	89.750
5	Holiday	23.325	Holiday					
6	26.175	23.400	13.500	13.300	10.500	10.000	26.000	89.500
7	26.475	23.550	13.500	13.300	10.500	10.000	26.000	89.500
8	26.575	23.875	13.500	13.300	10.500	10.000	26.000	89.500
9	No Market	23.875	13.500	13.300	10.500	10.000	26.000	89.500
11	Holiday	23.175	Holiday					
12	26.475	23.700	13.500	13.300	10.500	10.000	26.000	89.750
13	26.475	23.975	13.500	13.300	10.500	10.000	26.000	90.125
14	26.325	23.275	13.500	13.300	10.500	10.000	26.000	89.750
15	26.525	23.250	13.500	13.300	10.500	10.000	26.000	89.875
16	No Market	23.250	13.500	13.300	10.500	10.000	26.000	89.875
18	26.425	23.325	13.500	13.300	10.500	10.000	26.000	89.750
19	26.425	23.150	13.500	13.300	10.500	10.000	26.000	89.625
20	26.600	22.900	13.500	13.300	10.500	10.000	26.000	89.125
21	25.975	22.600	13.500	13.300	10.500	10.000	26.000	88.375
22	26.500	22.425	13.500	13.300	10.500	10.000	26.000	87.250
23	No Market	22.425	13.500	13.300	10.500	10.000	26.000	87.250
25	25.975	22.800	13.500	13.300	10.500	10.000	26.000	87.125
26	26.325	22.575	13.500	13.300	10.500	10.000	26.000	87.500
27	26.025	22.725	13.500	13.300	10.500	10.000	26.000	88.875
28	Holiday	22.225	Holiday					
29	26.525	22.375	13.500	13.300	10.500	10.000	26.000	91.250
30	No Market	22.375	13.500	13.300	10.500	10.000	26.000	91.250
AVERAGES FOR MONTH								
Nov.	26.339	23.109	13.500	13.300	10.500	10.000	26.000	89.359
AVERAGES FOR WEEK								
Nov.								
6	26.138	23.283	13.500	13.300	10.500	10.000	26.000	90.150
13	26.500	23.692	13.500	13.300	10.500	10.000	26.000	89.675
20	26.460	23.192	13.500	13.300	10.500	10.000	26.000	89.667
27	26.160	22.592	13.500	13.300	10.500	10.000	26.000	87.729

CORRECTION: Straits Tin N. Y. for week ending Oc t.23 should be 91.563.

CALENDAR WEEK AVERAGES								
Nov.								
2	26.170	22.875	13.500	13.300	10.500	10.000	26.000	90.875
9	26.338	23.558	13.500	13.300	10.500	10.000	26.000	89.550
16	26.450	23.438	13.500	13.300	10.500	10.000	26.000	89.875
23	26.385	22.804	13.500	13.300	10.500	10.000	26.000	88.563
30	26.213	22.513	13.500	13.300	10.500	10.000	26.000	89.200

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.400c per pound, the average differential for delivery charges.

(b) Our export quotations for copper reflect prices obtaining in the open market and are based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.125c for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West effective Jan. 1, 1951, commanded a premium of 1.35c per pound over the current market for Prime Western; Special High Grade 1.75c effective Dec. 1, 1955.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 pounds.

(g) The daily silver quotation reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually one quarter cent below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5 per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Nov. 1957	Silver (c) New York	Silver London	Sterling Exchange	Gold London	Gold (d) United States
1	90.625	78.750d.	279.5312	250s. 2d.	$35.00
2	(e)	(e)	(e)	(e)	35.00
4	90.625	78.750d.	280.0000	250s. 1½d.	35.00
5	Holiday	78.500d.	Holiday	249s. 9½d.	Holiday
6	90.625	78.500d.	280.0937	249s. 9½d.	35.00
7	90.625	78.500c.	279.9812	249s. 9½d.	35.00
8	90.625	78.500d.	280.0312	249s. 9¾d.	35.00
9	(e)	(e)	(e)	(e)	35.00
11	Holiday	78.500d.	Holiday	249s. 8½d.	Holiday
12	90.375	78.500d.	280.1562	249s. 8½d.	35.00
13	90.375	78.250d.	280.1875	249s. 8¼d.	35.00
14	90.375	78.250d.	280.0937	249s. 8¼d.	35.00
15	90.375	78.125d.	280.1562	249s. 8½d.	35.00
16	(e)	(e)	(e)	(e)	35.00
18	90.375	78.125d.	280.3125	249s. 7½d.	35.00
19	90.375	78.000d.	280.5312	249s. 5½d.	35.00
20	90.375	78.000d.	280.4296	249s. 2¾d.	35.00
21	90.375	77.875d.	280.3750	249s. 4¾d.	35.00
22	90.250	77.875d.	280.3750	249s. 4¾d.	35.00
23	(e)	(e)	(e)	(e)	35.00
25	90.250	77.875d.	280.6250	249s. 3d.	35.00
26	90.000	77.875d.	280.6875	249s. 1⅝d.	35.00
27	90.000	77.625d.	280.6250	249s. 2½d.	35.00
28	Holiday	77.625d.	Holiday	249s. 3½d.	Holiday
29	90.000	77.625d.	280.5000	249s. 3¾d.	35.00
30	(e)	(e)	(e)	(e)	35.00
AVERAGES FOR MONTH					
Nov.	90.368	78.173	280.261	—	35.00
AVERAGES FOR WEEK					
Nov.					
6	90.625	—	279.811	—	$35.00
13	90.500	—	280.089	—	35.00
20	90.375	—	280.305	—	35.00
27	90.175	—	280.538	—	35.00

CORRECTION: Sterling Exchange average for week ending Oct. 30 should be 279.956.

Calendar Week Averages: New York Silver: Nov. 2nd, 90.625; 9th, 90.625; 16th, 90.375; 23rd, 90.350; 30th. 90.063.

(e) No Market (Saturday).

London Metal Exchange Quotations

Nov.	COPPER Cash Bid	COPPER Cash Asked	COPPER 3 Mo. Bid	COPPER 3 Mo. Asked	LEAD Current Month Bid	LEAD Current Month Asked	LEAD 3 Mo. Bid	LEAD 3 Mo. Asked	ZINC Current Month Bid	ZINC Current Month Asked	ZINC 3 Mo. Bid	ZINC 3 Mo. Asked	TIN Cash Bid	TIN Cash Asked	TIN 3 Mo. Bid	TIN 3 Mo. Asked
1	190½	191	193½	194½	85½	85¾	85¾	86	68½	69	68½	68¾	730	730½	720½	721
4	187	187½	190½	191	84½	84¾	84½	84¾	67¼	67¾	67	67¼	730	730½	716	717
5	190	190½	193½	194	85	85¼	84¾	85¼	68	68½	67¾	68	730	730½	715	715½
6	193	193½	196½	197	85¾	86	85¼	85¾	68¼	68½	67¾	68	730	730½	715	715¼
7	194	194½	197	198	87¼	87¾	87	87½	69	69¼	68¼	68½	730	730½	715½	716
8	190	190½	194	194½	86¾	87	86¼	86½	68¾	69	68	68½	730	730½	716	716½
11	191	191½	195	195½	86¾	87	86¼	86½	68½	68¾	67¾	68	730	730½	715	715½
12	192	192½	196	196½	86¼	86½	85½	86	68½	68¾	67¾	68	730	730½	718	719
13	190½	191	194¾	195	84½	84¾	84¼	84½	68	68¼	67¼	67½	730	731	719	720
14	188¾	189	192¾	193	84	84¼	84¼	84½	67½	67¾	67¼	67½	730	730½	718½	719
15	191	191½	195	195½	84¼	84½	84¼	84½	67½	67¾	67½	67¾	730	730½	717	718
18	188	188½	192	192½	83½	83¾	83¾	84	67½	68	67¼	67½	730	730½	715½	716½
19	186½	187	190	190¼	82	82½	82¼	82¾	67¼	67½	66½	66¾	730	730½	713	714
20	184½	185	188¾	189	82	82¼	82¼	82½	67	67¼	66¼	66½	730	730½	709½	710
21	183¼	183½	187½	188	79½	80	80	80½	66¼	66½	65¼	65½	730	730½	704½	705
22	183½	184	188	188½	80	80¼	80½	80¾	66	66¼	65½	65¾	730	730½	680	681
25	184	184½	188½	189	79¾	80	80½	80¾	66½	66¾	66	66¼	730	730½	685	686
26	183½	184	187½	188	79¼	79½	79¾	80¼	66	66¼	65¼	65½	730	730½	689	690
27	183	183½	187¼	187½	78½	78¾	79¼	79½	65¾	66	65½	65¾	730	730½	700	701
28	183½	184	188	188¼	79	79¼	79¾	80	66¾	67	66¾	66¾	730	730½	716	717
29	184	184½	188¾	189	79½	79¾	80¼	80½	66¼	66½	66½	66¾	730	730½	717	718
Av'g's.	£187.929		£191.887		£83.167		£83.327		£67.527		£67.063		£730.262		£710.631	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.97%, zinc 98¾ and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments f.o.b. New York unless otherwise stated, tons of 2,000 lb. unless otherwise noted. St—short ton; lt—long ton.

MISCELLANEOUS METALS

November 30, 1957

Aluminum ingot, 99 plus % lb.		28.1¢
Antimony, spot, lb. less than carload, in cases		36.59¢
In bulk, carload lots, f.o.b. Laredo		33.00¢
Bismuth, ton lots, lb.		$2.25
Cadmium, commercial sticks, delivered, lb.		$1.70
Calcium, lb. ton lots, 98%, cast		$2.05
Chromium, 97% grade, lb. contract del.		$1.29
Cobalt, 97 to 99%, per lb. eff. Feb. 1, 1957		$2.00
Germanium, per gram, 10,000 gram lots	(c)38¢ @	(d)45½¢
Indium, troy oz.		$2.25
Lithium, lb. 98%	$11.00 @	$14.00
Nickel, cathodes, lb. (a)		74¢
Other sales, reg. sellers		74¢
Sales by dealers, etc	70¢ @	77¢
Magnesium, 99.8% carloads, lb. producer's plants, Velasco, Texas, eff. Apr. 16		35¼¢
Palladium, troy oz.	$21.00 @	$22.50
Platinum (wholesale lots), troy oz.	$77 @	$80
Quicksilver, flask of 76 lb., 25 flasks or more	$225 @	$230
Selenium, 99 plus %, lb. —(Nov. 18, 1957)		$7.50
Silicon, minimum 97%, carloads, lb.		22¢
Semi-Conductor grade, lb.		$350
Tellurium, lb.		$1.65
Thallium, 100 lb. or more, lb.		$12.50
Titanium, 99.3 plus, grade A-1, max. 3% iron, lb.		(b)$2.25

(a) Eff. Dec. 6, 1956; incl. U. S. duty; (b) Effective June 3, 1957.
(c) Delivered; (d) f.o.b. plant

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per short ton unit	$36.00 @	$37.00
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:		
44% Cr_2O_3 no ratio	$26 @	$26.50
48% Cr_2O_3 3 to 1 ratio	$47 @	$57
Iron Ore, Lake Superior, Lower Lake ports, long ton:		
Old Range bessemer		$11.85(e)
Mesabi bessemer		$11.60(e)
Mesabi, non-bessemer		$11.45(e)
Lead (Galena), 80%, Joplin, Mo., ton		$163.32
Manganese Ore—Per long ton unit of Mn basis 48% manganese, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports, import duty extra, export duty included. $1.36 @ $1.39; both duties excluded, $1.225 @ $1.255. Long-term contract nominal.		
Molybdenum Ore, 90%, per lb. of Mo f.o.b. mines	$1.18 @	$1.23
Columbium-Tantalum, per lb., combined oxides 10 to 1 ratio	$1.15 @	$1.20
Tungsten Ore, per stu of WO_3:		
Foreign 60%, c.i.f. U. S. ports, duty extra	$12 @	$13.25
U. S. scheelite, f.o.b. mill		$20–$20.50
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines		31¢
Zinc Ore, Prime, 60% concentrate, Joplin, Mo., per ton		$56

(a) Nominal.
(e) Eff. 1957 shipping season.

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb., in bbl. carload lots delivered		5½¢
Cobalt Oxide, 72½% to 73½%, per lb. eff. Dec. 1, '56	$1.52 @	$1.55
Copper Sulphate, 100 lb. eff. Sept. 3, '57		$11.55
Germanium Oxide, gram		27½¢
Molybdic trioxide, technical, per lb of Mo	$1.38 @	$1.41
Imported, incl. 37¢ duty	$1.75 @	$2.05

ALLOYS

Ferrochrome 65 to 70%, per lb. of Cr. (4-9% C)		28¾¢
Ferromanganese, 74 to 76%, per lb., shipg. pt.		12¼¢
Ferromolybdenum, 58 to 64% Mo, lb. of Mo contained	$1.68 @	$1.74
Ferrosilicon, 50% per lb. of Si f.o.b. shipping point (3-19-57)		14.20
Ferrotungsten, 72 to 82%, lb. of W contained		$2.15
Ferrovanadium, per lb. of V delivered	$3.20 @	$3.40
Silicomanganese, max. 1½% carbon, lb., contracts		12.8¢
Spiegeleisen, per long ton, 19 @ 21% grade eff. Jan. 7		$102.50

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (Canadian funds) ton:		
Crude No. 1	$1,470 @	$1,810
Crude No. 2	$788 @	$1,155
Spinning fibers	$353 @	$593
Shingle fibers	$190 @	$220
Paper stock	$120 @	$142
Waste	$82 @	$86
Shorts	$27 @	$75
Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):		
Crude No. 1		$1,522
AAA		$878
Asbestos, Vermont, f.o.b. Hyde Park:		
Spinning fibers	$353 @	$383
Shingle stock	$172 @	$190
Paper stock	$114 @	$145
Waste, stucco or plaster		$82
Refuse or Shorts	$39 @	$72
Barytes f.o.b. cars:		
Georgia, crude, per ton		$18
Missouri, 94% $BaSO_4$, per short ton	$16 @	$18
Crude oil well grade, min. 4.3% sp. gravity, st (a)		$18
Imported, c.i.f. Gulf Ports, st	$16 @	$18
Bauxite, long ton, f.o.b. point of shipment:		
Domestic, crude, 50 to 52% (not dried)	(c)$ 5.00 @	$5.50
Domestic, chemical, 55 to 58%	(c)$ 8.00 @	$8.50
Domestic, abrasive, 80 to 84%	(c)$18.00 @	$18.50
Imported metallurgical, per lt, f.o.b. Br. Guiana, dep. on grade		$7.14
Feldspar, bulk ton:		
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50 @	$22.50
Glass feldspar, white, 20 mesh	$10 @	$12.50
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37 @	$41
60% effective CaF_2	$33 @	$36.50
Acid 97% concentrate, bulk, ton (eff. 12-1-56)		$50.00
Some sellers quote		$55
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 @	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington		$46
Mica—Domestic, f.o.b. mines. Punch 7¢ to 12¢ per lb. according to size and quality. Sheet clear, 1½ x 2-inch, 70¢ to $1.10; 2 x 2-inch, $1.10 to $1.60; 2 x 3-inch, $1.60 @ $2.10; 3 x 3-inch, $1.80 @ $2.30; 3 x 4-inch, $2.00 @ $2.60; 3 x 5-inch, $2.60 @ $3.00; 4 x 6-inch, $2.75 @ $4.00; 6 x 8-inch, $4.00 @ $8.00. Wet ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground: $32.50 @ $70.00 per ton. Scrap, $25 and up.		
Ocher, Georgia, ton, in sacks	$26.50 @	$32.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports		Not quoted
Sulphur, per lt, f.o.b. U. S. mines: bright		$23.50
dark	$22.50 @	$23
Mexican, for use in Mexico, per metric ton, f.o.b. mines, 280 to 395 pesos, depending on use	$22.40 @	$31.60
For export f.o.b. vessel, lt, dep. on grade	$22 @	$24
Talc, f.o.b. works, ton:		
New York, purified	$18.00 @	$20.00
Vermont, extra white		$12.50
Tripoli, Missouri, ton:		
40-mesh, cream colored		$50.00

(a) Some restricted sales at $11.50. (b) Corrected. (c) Nominal.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces		$66.00
Steel, f.o.b. Pittsburgh, billets, net ton		$77.50
Structural shapes, Pa., Ala., etc., 100 lb.	$5.10 @	$5.275

THIS MONTH IN MINING

Industry Reacts to Johnson Speech

DESPITE THE MANY STORM SIGNALS and fore-warnings, announcement of curtailment of expansion in United States uranium mining and milling by AEC appeared to have caught many of the industry's western leaders "off balance." (*E&MJ*, October 1957, p 73.)

While no single man appears to be as highly regarded in the uranium business as Jesse Johnson, the talk he gave at the Atomic Industrial Forum on Oct. 28 has elicited a chorus of disapproval, directed not so much at him as at the AEC.

Firms and individuals with millions of tons of uranium in the Ambrosia-San Mateo areas of New Mexico and the Gas Hills-Crooks Gap area of Wyoming are those who have been hardest hit. Fate and timing have caught them up because miners in these areas depend completely on mill contracts.

"We have arrived at the point where it no longer is in the interest of the Government to expand production of uranium concentrates," Johnson said.

Mr. Johnson states clearly and emphatically that "under these circumstances, the Commission, at this time, is faced with limited commitments for additional domestic uranium production. Proposals for domestic contracts which already have been submitted and are under review still will be considered in the light of discussions which have taken place . . ."

Johnson went on to lay down the terms under which it is apparent only relatively minor expansion of mill capacity will be made between now and the end of the year. He says the Commission expects to be buying 15,000 tons of uranium concentrates by 1959. And he added that he didn't want to expand beyond the "existing (contract) commitments."

Disapproval from the westerners came on two scores. First, what the AEC is seeking to accomplish, (i.e. maintenance of exploration and creation of non-salable reserves) and second, the "justice" of picking and choosing among operators and districts.

For the small miner, prospector and company engaged solely in producing uranium ore, the handwriting is, they believe, boldly on the wall.

If he has a mill contract or connections, he must seek immediately to mine out his reserves. If his reserves are sufficient to meet mill commitments between now and Mar. 31, 1962, he must get out of the business of exploration for new ore for which there will be no market and from which he, of course, could never recover exploration costs.

(Ironically, the AEC's announcement came on the heels of approval for about six new contracts by Defense Minerals Exploration Administration involving uranium search.)

"Now, more than ever before, you can see what effect the abandonment of the buying station program by AEC had done to the promises implied in the Circular 5 purchase program," a spokesman for a non-integrated company told *E&MJ*.

Under Circular 5, the AEC commits itself to buy uranium-vanadium ores (carnotite-roscolyte ores) up to the '62 date. By practice, however, the AEC extended purchasing to limestone ores, reserves of which are now staggering.

Open-end buying at the stations resulted in creation of big stockpiles. As mill contracts were granted in new ore areas, the AEC abolished its station on the basis that there was an "assured market" at the privately operated mill.

This might have been true, the uranium miners say, so long as the Government continued to approve mill expansions or new mills. In fact, there was a period in some districts during 1955 through early 1957 when ore reserves were being bought and sold at fabulous prices by those seeking to get into the milling business.

With the end of mill expansion, the bargaining position of the mine owner is ended. In fact, he might well be ended himself, if he doesn't make a market.

Consequently, it is just beginning to dawn on the western man on the street that there really isn't any "guaranteed purchase program" for every bit of uranium ore produced at this time. That "guarantee" ended Monday, Oct. 28, 1957 at the Atomic Industrial Forum meeting in New York City. It "ended," they say, nearly five years before it was supposed to.

It is on this score that the AEC might receive political attack from Western senators and congressmen, regardless of what contributions the Commission has made in the past to the region's mining industry. It will be charged that the AEC has "gone back on its word." (It's not, "What you have done for me?," it's "What have you done for me lately?")

Men of the mining industry regard the hopes of the Commission about continued exploration for ore and ore reserves as "pious." Who, they ask, would continue exploration for a material for which there was no purchaser—or a market based on the vague hope of some later resumption of open end ore purchasing by the Government?

The keenest disappointment is felt, of course, by those in the industry who have submitted or were planning to submit proposals for mill expansion or new mills.

A commission spokesman at Grand Junction Operations Office stated there would be "some" new capacity approved at the Gas Hills area. He reminded *E&MJ* that to date there was pending before the commission, mill proposals totaling 4,000 to 5,000 tpd of ore. The AEC definitely will not "buy" all of them, he stated.

Those with pending proposals for increases of existing mills include: Lucky Mc Uranium, up 1,000 tons from 750 tons, and Western Nuclear, up 800 tons from present capacity of 400 tpd.

Those seeking new mills include: An affiliate of Susquehanna Corp. at Riverton, Wyo.; Globe Mining & Milling with Union Carbide Nuclear. They have completed new proposals before the AEC.

Susquehanna's proposition for a custom mill as been processed by Grand Junction and is now in Washington, D. C. for AEC okay. This permit is given the best chance of approval even though Susquehanna has no known ore reserves.

Just prior to Johnson's announcement, Floyd B. Odlum's Atlas Corp. with Vitro Minerals Corp. (Vitro Corp. of America-Rochester & Pittsburgh Coal Co.) submitted a proposal for a 1,000-tpd mill in Gas Hills district. Vitro earlier was reported negotiating with Lucky Mc Uranium, et al, for inclusion in the expansion of the Lucky Mc mill. Phelps Dodge Corp. would have a share in this expansion.

Also, Federal Uranium Corp. has proposed a mill in the Gas Hills district and is (or was) in process of "formalizing" this proposal.

In the San Mateo, N. M. area, Rare Metals Corporation of America was hopefully pursuing a mill program for an 800,000 (plus) ton reserve. And Lisbon Uranium et al, under an E. J. Longyear directed program, was developing a potentially large uranium body at last report.

Lisbon also has had success in the Big Horn Mountain area of Wyoming.

Northwest Uranium Corp. of Salt Lake City, Utah was pursuing an upgrading facility or mill in the Spokane Indian reservation. There is renewed exploration in the fissure-system Marysvale district of Piute County, Utah, where Vanadium Corporation of America has renewed conversation about a mill.

Rare Metals Corporation of America also wants to expand its mill at Tuba City, Ariz. There are a number of plans for other mills of small capacity in the White Canyon district of Utah and in western Colorado.

The Commission spokesman at Grand Junction said the AEC would consider granting contracts for concentrate purchasing in areas not now served by mills. This is supposed to serve as a stimulus for reserve "maintenance." Mentioned specifically were the Apex Mining Co. proposal for Austin, Nev., and the Garth and Vance Thornburg

mill proposal for the Lakeview ore area. See column at right.

Some Wyoming and New Mexico miners allege such expansion would be wasteful of funds and would serve no purpose. But Grand Junction announced several months ago that price per pound of concentrates was not the only criteria in determining mill location.

Custom capacity, dovetailing with AEC policy, etc., are of equal or possibly greater importance, the uranium industry was informed.

In making its decision to limit expansion, the AEC has had to create an inequity—with a newer district like Gas Hills and Crooks Gap in Wyoming suffering the most.

But apparently a decision had to be made. Some westerners are convinced it was made because AEC is "bumping its head on its budget." Defense of commitments made to date for uranium purchasing may prove difficult in years ahead as the magnitude of these appropriations for ore and concentrates becomes known generally, it is argued.

A study of existing and committed mill capacities for uranium in western United States discloses that the Atomic Energy Commission already is looking toward an early implementation of its 1962-66 concentrates purchase program.

The reason: analysis of present and pending mill contracts for concentrates' sale to the government discloses that the domestic industry by end of 1959 will be selling a good deal more than 15,000 tons of concentrates annually.

It was this figure which Mr. Johnson referred to on several occasions in his talk as apparent optimum goal of purchasing.

Latest report from AEC shows some 20,310 tons of daily ore capacity in about 23 approved mills scheduled for the period ending in 1959. Mr. Johnson said he wanted to keep capacities in future at about existing committed levels. But he used the term "15,000 tons

(Johnson Speech continues on p 136).

Mining Calendar

Institute of Metals, (London) inaugural meeting of powder metallurgy group. Church House, London, Dec. 4

Governor's Industrial Safety Conference (California). Eighth annual meeting. San Francisco, Feb. 6-7

National Western Mining Conference, Feb. 6-8, Denver, Colo.

AIME, annual meeting. Hotel Statler and Sheraton-McAlpine, New York. Feb. 16-20

Pacific Southwest Conference, AIME, St. Francis Hotel, San Francisco, March 17-29.

American Chemical Society, 133rd National Meeting, San Francisco, April

13th Purdue Industrial Waste Conference, Purdue University, LaFayette, Indiana, May 5-8

(This Month continues on p 136)

As We Went to Press . . .

Quicksilver producers were helped by GSA announcement of the following change in the deadline for mercury shipments under the U.S. and Mexico Purchase Program—"In view of the timing problem encountered in securing specified flasks . . . to meet 1957 delivery, tenders of mercury made on or before Dec. 31, 1957 are to be applied to quantities authorized for acceptance under the quota expiring Dec. 31. Mercury so tendered must be actually available in 1957, except for packaging requirements, and . . . must be delivered, properly packaged, not later than Mar. 31, 1958."

Properly packaged refers to a Nov. 8th GSA cut in flask specifications which says: all shipments must be in flasks formed from seamless wrought-iron or steel tubing with a swaged, concave bottom and 1-in. drain plug. Top must have ½-in. pipe thread collar welded in place. Stopper must be iron or steel screw cap with ⅛ in. transverse hole. Flasks must be rust-free and in good physical condition. Producers had complained that flasks of original specs were not available and even reduced specs came too late to make deliveries before end of year.

Anaconda Co. has exercised an option on a large iron ore property in northern Ontario, 40 miles north of Nakina. Anaconda will pay some $10-million over an extended period for the property, running 64 to 68% Fe, held jointly by Lake Superior Iron Ore Co.. and Jean Gourd Syndicate. Anaconda has no immediate mining plans.

Atomic Energy Commission says that Lakeview Mining Co., Lakeview, Ore., has been granted a uranium milling contract. Mill to treat 210 tpd will be erected at Lakeview at a cost of some $2.6-million. This will be the first Oregon mill. Dr. Garth Thornburg, Lakeview president and associate with his brother, Vance, in Gunnison Mining Co., added that some custom ore will be milled.

Bauxite exploration and mining concession has been obtained by Kaiser Aluminum & Chemical Corp. from the government of Panama, subject to legislative approval. D. A. Rhoades stated that the contract, first such ever granted by the government, gives Kaiser exclusive rights to a large area in northern Panama, near Costa Rica.

Dow Chemical Co. has purchased, for a considerable sum, several lithium-pegmatite claims recently filed on state-owned land near Thomaston, Maine. At the present time 14 mining companies and 5 diamond drills are seeking Maine's mineral resources.

Kermac Nuclear Fuels Corp. has let a $1.5-million contract to erect a transmission line from Albuquerque to Kermac's Ambrosia Lakes mill. Public Service of New Mexico will build the 70-mile 115-kv line. Phillips Petroleum Co., building a $9.5-million mill in the area, holds a one-third interest in the power line.

Justice Dept. report states that "the U.S. tungsten buying program has met the original objective—an adequate supply." Report also said that "domestic tungsten industry has remained small, and is precariously dependent, not on domestic competition, but upon . . . operations of richer, more economically worked foreign deposits."

Behind the By-Lines...

Ye Christmas Greetings

In greetings now we call the role,
Of mining men from pole to pole.
Strike the harp and ring the chimes
Never mind these parlous times.
Put a smile upon the face
That glumly stares at outer space.
The situation could be more drastic,
Were the Sputniks made of plastic.

While present prices are most improper
For selling zinc or lead or copper,
Let's heed the words of Roy H. Glover,
In '58 we will recover.
Meanwhile, let's join in celebration,
A round of yuletide jubilation.
We'll show the world we're hale and hearty,
With a rousing mineral party.

String the colored lights 'round
For all in pit and underground.
Lots of fa-la-lal-de-rol
Along the Rand and at Transvaal,
Rally round the tannenbaum
For ye Campbells, Walt and Tom
Phil Holdsworth and Sheila Deane,
Paul F. Yopes and M. L. Steen.

At Port-au-Prince, some stabilization
For E. J. Ryan and Reynolds' Haitian.
Glist'ning holly leaves and yews
To the Moly Mountain News,
R. J. Henry, Eldorado;
E. H. Crabtree, Colorado.
Gerry Pierce and Charlie Towle
Meet us at the wassail bowl.

Let's not forget our season's duty,
To list our hopes for Christmas booty.
May lead and zinc men have a ball,
Dancing on a tariff wall
We certainly hope, from their lofty perch,
They take a look at market research.

Pluck the rose and strew the petal,
For newlywed Climax and American Metal.
A share of yours for a share of mine,
Oh won't you be my Valentine?
A toast to future corporate splices
One of mining's slick devices,
For that's the way we'll end the jokes, men,
About our twenty different spokesmen.

Let the Christmas tree be bowed
With presents for the lithium crowd,
For men at Hibbing, men at Butte,
At Grass Valley, Pas-des-Chutes,
Denver, Carlsbad, Chino, too,
Ottawa and Chibougamau.
Tap again the flowing cask
For friends at Athabaska, Sask.

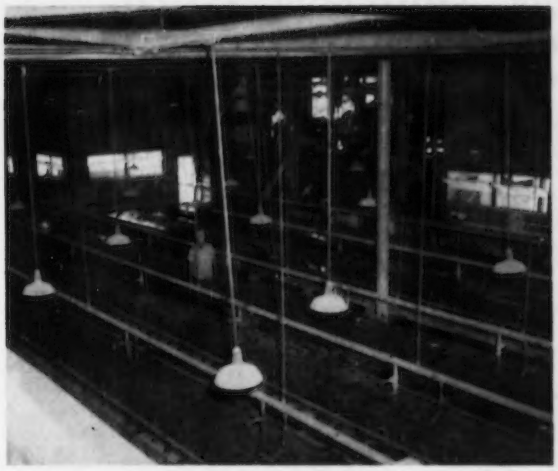
We hope the season is all fun
For Senator Clinton Anderson,
For all who make aluminum foil,
And for Mrs. Foote's boy, Royl.
The best of New Years now we see
For all who toil in the Caribbee,
The Lowreys, too, and Severn Brown,
And all who live in an Inco town.

What bothers us at Christmastime
Is the number of friends we cannot rhyme,
Lukkason, Ffolliott, Romagosa, Bechaud
Nininger, Oppenheimer, Shearman, Pofcher
Gustafson, Vener, Edge, and Koenig
The thing could make you schizophroenig!

Let goodies spill from Santa's pack
For Donald White and Peter Black
For Roger Pierce, Pierre Ledoux
For Larry Roe and Raymond, Lou
For Dr. Kerr and Thomas Payne
For Grover Holt and Kremer Bain
For Charlie Brown at Electromet
Have we greeted Gaffron, yet?

Season's greetings we impart
To Viola Mac and Lyman Hart,
The Schislers down at Moa Bay,
Langbourne Williams, William Shea.
Hang the baubles, toss the tinsel
Sherman White, Augustus Kinzel
Robert Ramsey, J. F. Hobbins.
Merry Christmas, Feierabends!

Our best to those who oversee
The doings at Mattagami,
To Janet Cardow, mining fan,
And Julian's Friday, Marianne.
And our respects we now do pay
To helpers, Bartlett and Roget.
Let's face it, men, we'd never forge
These lines without ol' Lutjen, George.



CONCENTRATING minus 20, plus 48-mesh Florida pebble phosphate is done with belts at Coronet's Tenoroc washer.

"GUIDED by bars, baffles and water jets, pebble agglomerates and leaves the belts at the sides"—Lacy Wester, metallurgist.

How Coronet Uses Belt Concentrators

ONE OF FLORIDA'S oldest pebble phosphate producers, Coronet Phosphate Co., Div., Smith-Douglass Co., Inc., uses patented belt concentrators, instead of the agglomerating tables normally used, to recover minus 20-plus 48-mesh rock.

The mine, called Tenoroc, is located nine miles northeast of Lakeland, Fla. It mines and treats 400 to 450 cubic yards of matrix per hour. Three Bucyrus-Erie draglines (11-, 8½- and 8½-cu yd buckets) dig and deliver the matrix to wells, where Georgia Iron Works pumps are installed to transport the matrix to the wet plant about 1,000 yards away.

Matrix line, like most others in the Florida phosphate industry, is Armco Spiralweld pipe, which is turned several times during its wear life. Mine, wet and dry mills are under the supervision of W. H. Taylor, general superintendent and L. G. Wood, mine superintendent. Three assistant mine superintendents direct the various phases of the operation—John Eady, Ray Drawdy and Lacy Wester.

Deposit runs 3 to 4% pebble and up to 40% clay, making for longer than normal (for Florida pebble operations) pipe and pump life. Standard operating practice is to run the pumps, pipe and dragline buckets (with an occasional change of teeth) to destruction.

Matrix comes to a washer where plus 14-mesh pebble is removed and hence to a feed tank at the wet plant, and is pumped at 12 to 17 psi to seven 24-in. DorrClones. Cyclones are fitted with newly designed, individual submerged discharge boxes that replace and eliminate the need for an apex valve. Cyclones deslime at 150 mesh, with overflow being disposed of immediately to the slime ponds. Cyclone underflow runs about 60% solids.

DESLIMING is done with seven 24-in DorrClones overflowing to waste.

From the cyclones, pulp follows the flowsheet shown here, with a 48 to 65 mesh split being made in the Fahrenwald sizers. Minus 65 mesh goes to flotation. Coarse (plus 16 mesh) goes to the finished pebble stockpile, and the plus 65 mesh fraction enters the belt concentrating section of the wet mill. Belts were designed from a patent obtained by Dr. E. W. Greene and Robert M. Wilbur, present manager of Coronet's Florida division.

Belts are continuous on 70-ft centers and substitute for the agglomerating tables used in most Florida pebble washers for minus 14-plus 65-mesh feed. Pulp goes from the Fahrenwald sizers to a head tank, then into a Simplex spiral classifier for further dewatering and desliming. Sand from the classifier screw is passed to a drum conditioner, where caustic soda, tall oil and fuel oil, the agglomerating agents, are added.

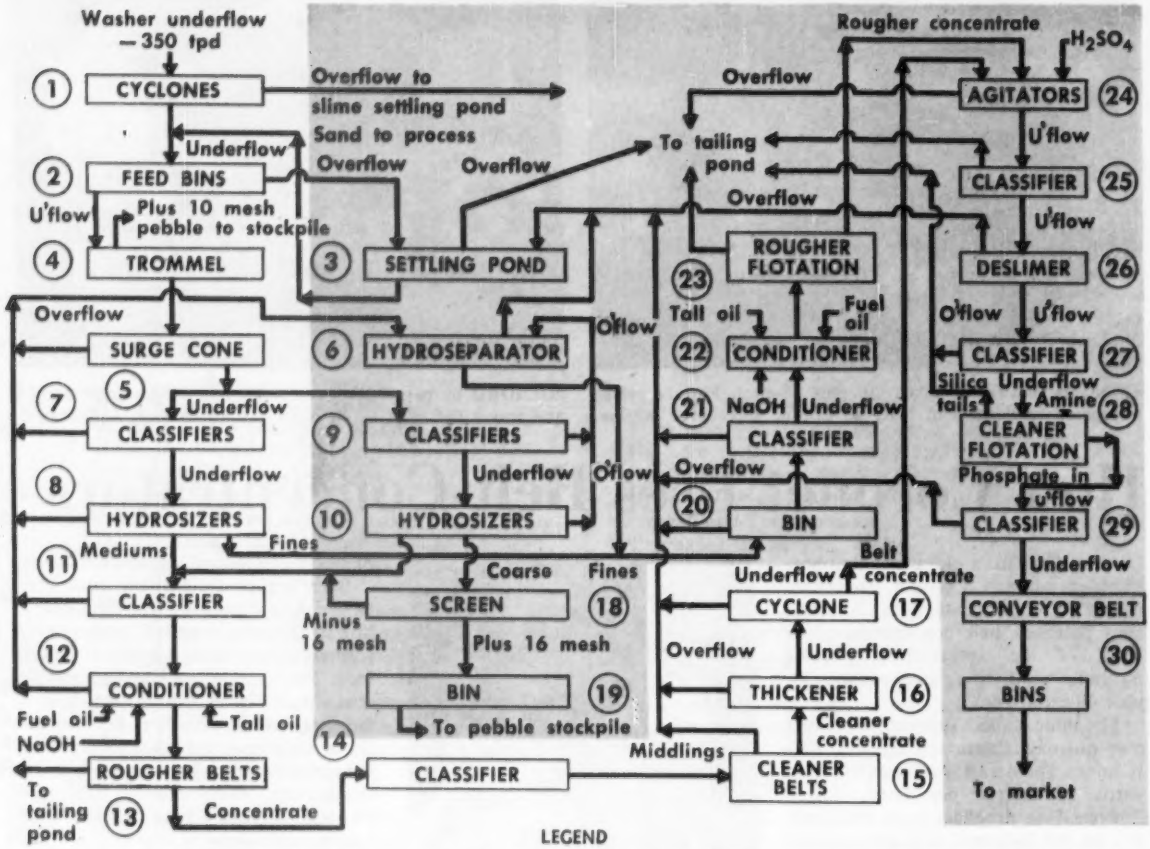
Three 42-in. wide belts treat the pulp in the rougher circuit. Pulp is dropped on the upstream end of the moving belt. A system of bars and baffles keep the feed herded toward the center of the belt. The bars create turbulence and a mixing action, while the baffles lead the floated agglomerates off the sides of the belt.

Water jets centered the length of the belts create the necessary aeration, freeing the agglomerated phosphate from the silica gangue so that the agglomerates run off the sides of the belt. Tailings are mostly silica and go directly to the tailing pond from the downstream end of the belt.

Rougher concentrate is collected in launders under the three rougher belts and delivered to a pump that sends the concentrate up to another Simplex spiral classifier, whose overflow goes to a general settling pond for eventual return to the plant circuit. Classifier sand drops down onto two 60-in. wide by 70-ft center cleaner belts.

Concentrate from these two cleaner belts joins the rougher flotation concentrate (see flowsheet) to be dewatered, de-oiled, dewatered again, and sent through the cleaner flotation

CORONET PHOSPHATE CO., DIV., SMITH-DOUGLASS CO.
PEBBLE PHOSPHATE WASHER FLOWSHEET
TENOROC, FLA.



LEGEND

1. Seven 24-in. DorrClones fitted with individual submerged discharge boxes that eliminate need for apex valves on these desliming units. Cyclones deslime at 150 mesh, with overflow going direct to slime disposal. Underflow is about 60% solids on 12 to 17 psi feed pressure
2. Two 40-ft feed bins located directly under the cyclones. Overflow goes to settling pond, and underflow goes to plant circuit
3. Settling pond collects all overflows and phosphate-containing washes through a catch-all pump, and returns both overflow and underflow to the plant circuit
4. Trommel screen washes and separates plus 10-mesh pebble for the stockpile. Underflow goes to surge cone
5. Surge cone continues the desliming step, sending overflow to a 40-ft Hydroseparator. Underflow is split to a 12-ft Dorr rake and a 6-ft rake
6. Hydroseparator, 40-ft dia, collects overflow from No. 5, 7, 8, 9 and 10, and sends it to the settling pond
7. Dorr rake classifier, 12 ft wide. Overflow goes to No. 6. Underflow goes to No. 9
8. Four 8-pocket Fahrenwald hindered settling sizers, made by General American Transportation Corp. Overflow goes to No. 6 and underflow is split into two products. Plus 65-mesh goes to No. 11. Minus 65-mesh goes to No. 20
9. Dorr rake classifier, 6 ft wide. Overflow goes to No. 6. Underflow goes to No. 10
10. Two 8-pocket Fahrenwald sizers by General American Transportation Corp. Overflow goes to No. 6. Underflow plus 65-mesh goes to No. 11. Underflow minus 65-mesh goes to No. 20. Underflow plus 16-mesh goes to No. 18
11. Simplex screw classifier, 66-in. dia, whose overflow goes to No. 6. Underflow enters conditioner at No. 12
12. Drum conditioner. Caustic, tall oil and fuel oil are added
13. Three 42-in. wide by 70-ft centers, continuous rubber belts fitted with bars, baffles and water jets that separate agglomerated pebble. Tailings off the ends of the belts go to the tailing pond. Concentrate from sides of the belts goes to No. 14
14. Simplex classifier, 54-in. dia screw. Overflow returns to No. 3. Underflow feeds to No. 15
15. Two 60-in. wide by 70-ft centers, continuous cleaner belts fitted with bars, baffles and water jets. Tailings off the ends of the belts are considered middlings and returned to No. 3. Concentrate from the sides of the belts joins rougher flotation concentrate after steps No. 16 and 17
16. Concentrate thickener, 30-ft dia. Overflow goes to No. 3. Underflow goes to No. 17
17. Cyclone, 24-in. dia, whose overflow returns to No. 16. Underflow feeds to No. 24
18. Two Allis-Chalmers vibrating screens with 16-mesh cloth. Oversize moves to pebble stockpile. Undersize returns to No. 11
19. Bin to deliver plus 16-mesh rock to pebble stacker belt
20. Flotation cell feed bin. Overflow enters No. 3. Underflow to No. 21
21. Dorr rake classifier, 16 ft wide. Overflow returns to No. 3. Underflow feeds No. 22
22. Three 2-cell conditioners. Caustic, tall oil and fuel oil are added
23. Four 4-cell banks of Mineral Separations' flotation machines. Underflow is tailings
24. De-oiling agitators take agglomeration-flotation concentrates and de-oil with H_2SO_4. Overflow passes to tailing pond
25. Two 54-in. dia Simplex classifiers split discharge from the de-oiler
26. V-box deslimer further deslimes and cleans concentrate
27. Two 54-in. dia Simplex classifiers split underflow from No. 26. Overflow is a tailing. Underflow feeds to flotation
28. Two 6-cell banks of Mineral Separations' machines. Amines float the silica
29. Duplex classifier, 54-in. dia screw, dewaters for stacker belt
30. Concentrate stacker belt delivers from four 200-ton bins to stockpile or bins deliver directly to the railroad for delivery to market or to Coronet

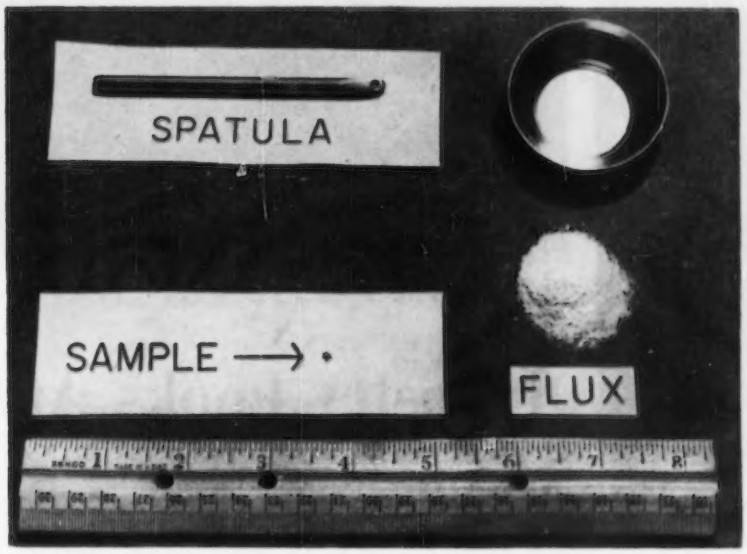
bank where silica is floated with amines. Phosphate remains in the underflow and is dewatered, and sent to the nearby drying plant.

Tailings from the cleaner belts are considered middlings and are sent to the settling pond for eventual return to the head of the circuit. All overflow and wash water, except that from the seven desliming DorrClones, is collected in a common sump and returned to the head of the circuit. Agglomerating belts last about five to seven years, requiring little or no maintenance.

Tenoroc produces pebble rock and agglomeration-flotation concentrate, and ships to market from the stockpile, or dries, blends and grinds as required. In addition, Tenoroc supplies Coronet with concentrate for the deflourination operation, by which fluorine is removed to make the phosphate available and non-toxic as an animal feed supplement.

E&MJ wishes to thank Robert M. Wilbur, manager, L. G. Wood, mine superintendent, W. H. Taylor, general superintendent, C. A. Hollingsworth, research director, Lacy Wester, metallurgist, and the staff at Tenoroc for their many courtesies extended during our recent visit to the mine and washer and Coronet's defluorinated feed supplement unit at Coronet, Fla.

We are indebted to Coronet Phosphate Co., Div., Smith-Douglass Co., Inc., Norfolk, Va., for their permission to publish this article.



TWO MILLIGRAMS of uranium ore fused with a definite amount of flux to produce green fluorescence which is then measured by a fluorimeter. Spatula measures out ore sample.

Fluorimetric Technique Compares Favorably with Chemical Analyses of Wyoming Uranium Ores
(Per cent by weight)

Gas Hills ores		Shirley Basin ores	
direct fluorimetric	chemical analysis	direct fluorimetric	chemical analysis
0.08	0.07	0.16	0.14
0.03	0.03	0.02	0.01
0.009	0.009	0.03	0.03
0.05	0.05	0.11	0.09
0.10	0.10	0.006	0.007
0.23	0.25	0.07	0.07
0.17	0.18	0.12	0.15
0.28	0.27	0.14	0.15
0.19	0.17	0.07	0.07
0.17	0.13	0.06	0.06
0.12	0.13	0.005	0.005
0.35	0.41	*0.24	0.32
0.52	0.57	0.49	0.53
0.50	0.45	0.90	1.00
0.76	0.86	0.60	0.64
0.33	0.36	0.69	0.74
0.43	0.46	0.34	0.31

*Organic matter present.

Simple Fluorimetric Scheme Speeds Uranium Tests

A NEW APPROACH to fluorimetric uranium analysis, used successfully for large scale testing of samples from Wyoming's Gas Hills and Shirley Basin areas, has cut the time and cost required to perform routine tests.

All uranium compounds display brilliant green fluorescence after fusion with a fluoride. The intensity of the fluorescence in the melt is directly proportional to the amount of uranium present. Tests now in use call for direct fusion of an accurately measured three milligram sample, and are reported to be useful for measuring small amounts of uranium (0.001% to 0.01%).

For most accurate results, possible quenching elements should be removed before fusion, either by chemical separation and/or by dilution.

Now, in what is claimed to be a more rapid method and one with wider application, the tedious milligram measurements are eliminated. Samples are measured mechanically by a small, specially constructed spatula (a depression in a flat piece of steel) which doles out approximately two milligrams of ore. Following fusion with a measured amount of flux, a sensitive fluorimeter, calibrated by using ore samples of known concentration, makes final measurements. Better results may be obtained by calibrating with standard ore samples from the same area.

Test developers (Billings, Mont., assaying laboratories of Yapuncinch-Sanderson & Brown working in cooperation with Globe Mining Co., Casper, Wyo.), make no claim to high accuracy, but say that the method is sufficiently precise to be used to block out orebodies. Ore samples with iron, heavy metals and organic matter cause serious error and require chemical checks.

Fluorimetric tests have, so far, been confined to Wyoming areas, but the method will find application in other areas, Y.S. & B. believe.

CORRECTION

Sir:

Congratulations on your Caribbean issue (*E&MJ*, September 1957). I believe you have done the mining industry a great service.

There was one small error in reporting the (Matahambre) production. At year-end June 30, 1957, Matahambre produced 278,800 tons of ore in 287 operating days, thus averaging 971 tons per day instead of the 700 tons reported. A large portion of this production (is from) small, widely scattered stopes . . . and our mining department deserves full recognition for this major achievement.

Arthur P. Nelson
General Manager

To feed the open hearths. . . .

to substitute for blast furnaces. . . .

Industry Looks At

JAMES W. FRANKLIN

DIRECT REDUCTION of iron ore in the U. S. took one giant step forward late in October when Alan Wood Steel Co. announced that they would build a 50-tpd H-Iron plant. Powdered metallurgy grade iron will be produced by direct reduction with hydrogen. This will be the latest commercial application of direct reduction in the U. S. There are others.

H-Iron is one of many direct reduction methods under development around the world. It is the brainchild of Hydrocarbon Research Inc. and Bethlehem Steel Co. Process combines petroleum and metallurgical techniques to produce metallic iron from fine iron ore using partially oxidized methane as a reducing agent. As a matter of fact, any hydrogen source can be used to provide the needed hydrogen.

Alan Wood says that they intend to enter the growing powdered metal supply picture, where a current market for about 35,000 annual tons exists. Much of this metal is imported, especially from Sweden. Direct reduction, particularly those processes using fluidized reactions, can make a competitive product; not only competitive in the powdered metal field, but also competitive with pig iron and No. 1 scrap in some areas of the U. S. and the world.

That's why Alan Wood is building the H-Iron plant. Not only will the process enable them to enter the powdered metal field, but excess capacity from the process will provide Alan Wood with a high quality melting stock for open hearth or electric furnace feed—getting Alan Wood out of the scramble for No. 1 scrap and high-grade lump ore needed to charge the furnaces.

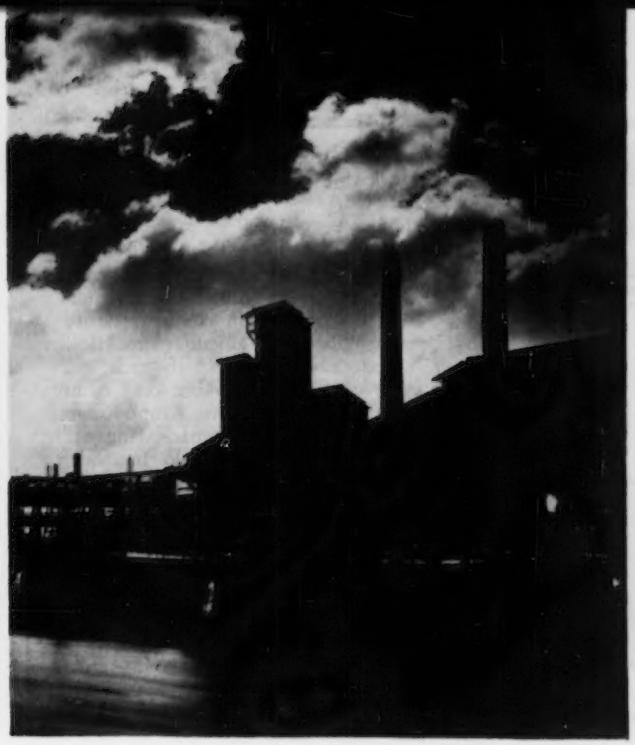
Where Direct Reduction?

Powdered iron and high-grade melting stock are only two of the many advantages of a direct reduction process. What are the others? Where does direct reduction fit into the steelmaking picture? Certainly not as a replacement for our blast furnaces. No one would tear down a multi-million dollar installation for any new process, particularly when that installation is a tried and true approach. But there are many instances where direct reduction shows advantage. Here's what a survey of the industry suggests.

It can be added to an integrated open hearth plant as a substitute for purchased No. 1 scrap or high-grade lump ore. Typical open hearth charge is 58% hot metal from the blast furnace, 35% scrap, 6% lump ore and 1% alloy. This 35% scrap is made up of 25% home-generated scrap and 10% purchased material. In most cases the 6% lump is also purchased. The steelmaker buys what he can, where he can.

But the price of either is as volatile as the supply. And the scrap quality is not always No. 1. He can substitute direct reduction for both purchased scrap and purchased lump. Russel MacMullan, Hydrocarbon Research Inc., stated that a typical open hearth charge with H-Iron would be as follows: 58% hot metal, 25% home scrap, 1% alloy and 16% H-Iron briquettes.

H-Iron has several advantages here. Pricewise, it can be made at a point that nears the present price of No. 1 scrap ($34 a ton, Pittsburgh). Only a 70% reduced ore is required, since the oxygen present is of some value in the open hearth. And this oxygen



. . . .in local steel markets

. . . .to conserve coking supplies

Direct Reduction

is uniformly distributed throughout each iron particle. Also, there would be no alloy metals to account for.

Direct reduction can be added to an integrated electric furnace plant. which normally uses 100% scrap charge. Direct reduced iron ore—H-Iron—says Hydrocarbon Research, can be used to replace up to 100% of the purchased scrap. This would get the electric furnace producer out of the scrap hassle. In this case, the H-Iron would have to be 95% reduced. A typical charge would be 50- to 70% H-Iron and 30- to 50% home-generated scrap.

New construction might favor direct reduction. Both Hydrocarbon Research and R-N Corp., holders of the R-N patent, say that a direct reduction set-up and an electric furnace plant would cost only 50% of the cost of a blast furnace, its coke ovens, sinter strand and an open hearth of equal capacity. Hydrocarbon's MacMullan quoted these figures—a 1,000-tpd blast furnace and attending equipment would cost in the neighborhood of $30-million. On the other hand, an electric furnace-H-Iron facility of equal size could be built for only about $12-million. That's quite a capital cost saving. And as each year goes by, the capital cost of steelmaking continues to rise.

The number of electric furnace installations is on the rise, because with a good supply of melting stock an electric furnace is cheaper to build and to operate than an open hearth. Electric power supply has never been a real drawback to installing an electric furnace. Scrap supply has. Direct reduction can replace and eliminate the scrap problem.

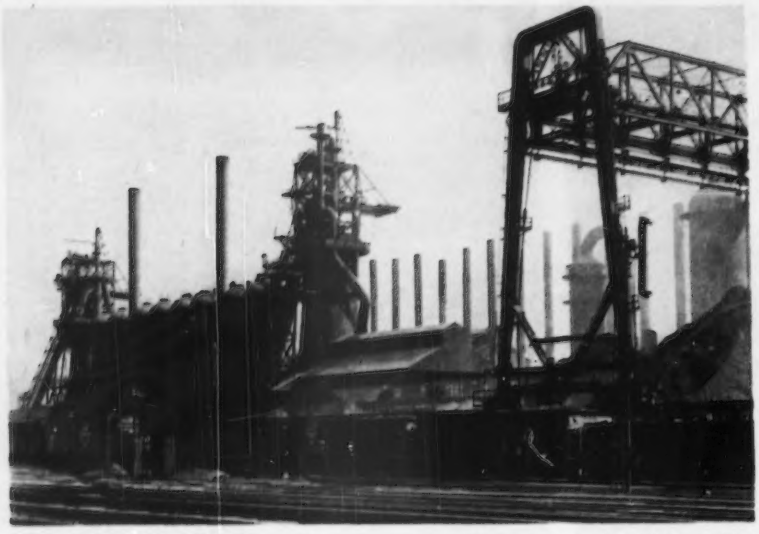
Besides, no one builds a small blast furnace. To be economic, a blast furnace must be large and in continuous operation. Where increases in capacity of less than 1000 tpd are envisioned, direct reduction and the electric furnace should be most attractive, both from a construction and operating cost viewpoint.

Expansion-minded steelmakers can use direct reduction and electric furnaces for the cost reasons above.

New construction in local markets can consider direct reduction with electric furnaces from capital and operating cost position, particularly if the local market has a ready supply of a cheap reducing agent. Texas has plenty of natural gas. There's plenty available in Western Canada.

Coke-poor regions of the world can have those steel mills they want with a direct reduction process. Fluidized solids processes can use almost any fuel as a hydrogen-carbon monoxide source—low-grade coal or coke, coke breeze, fuel oil, natural gas, lignite, catalytic reformer gases and even chars can be used.

Iron ore-rich exporting nations can have their own steel mills at a lower capital cost with direct reduction—even those that are coke poor. Direct reduction can be used to provide stock for open hearths or electric furnaces, as well as provide a higher grade, more valuable export commodity. Instead of exporting iron ore, they could export reduced iron. Furthermore, these countries could make more use of the large naturally occurring fine ore deposits that at present have a limited or no market except to a steelmaker with a sinter strand. (*Continued on next page*)



DIRECT REDUCTION will come; not as a replacement for multi-million dollar blast furnaces now in operation, but in new installations and local expansions.

Iron ore companies could install a direct reduction plant to treat the fines now going to the sinter strand or on the dump. Southwestern Engineering Co. says that it has been proven that a Krupp-Renn Process kiln can make reduced iron at a lower cost than it would take to sinter the same fines. An ore beneficiating plant could consider direct reduction as an alternative to agglomerating and pelletizing. It would cut freight costs for both coal up to the mine and product down to the market, and provide a higher grade furnace feed.

Direct reduction can be used to upgrade low-grade ores or to reduce high-grade fines or concentrate. Some processes will remove only the oxygen and a little sulphur. Others, by producing a slag, will remove silica, alumina, sulphur, phosphorus and trace elements.

Limited coking quality coal areas can consider direct reduction using any other hydrogen source, since it often happens in these areas that the coking coals are more valuable to the organic chemical industry than they are to the ferrous iron and steel people.

What Processes Are Available?

Thermodynamically the blast furnace has been called a lazy nuisance, but no other piece of smelting equipment can compare with it for throughput, day in, day out—capacity-wise, the blast furnace is a hog. None of the direct reduction processes under present development are going to push a blast furnace off its foundation. Direct reduction has its place in the iron and steel industry as an alternate route, not a replacement.

Direct reduction may be divided into two types of processes: those using gaseous reducing agents in a fluidized reaction, and those performed in shaft furnaces, kilns or retorts.

Many processes are available for consideration in addition to H-Iron, R-N and Krupp-Renn mentioned above. Presently three direct reduction methods are in commercial use —the Wiberg and Höganäs Processes, both treating a very high-grade ore in Sweden, where coking coal is in short supply, and the Krupp-Renn. Wiberg uses a shaft furnace. Höganäs and Krupp-Renn are kiln methods. Alan Wood's H-Iron installation will be the second commercial fluidized gaseous reduction attempt.

Direct reduction processes may or may not remove impurities in the ore, depending on the method. Kiln processes, shaft furnaces and retorts that produce a slag, can remove impurities. Fluidized gaseous methods can only remove oxygen and a little sulphur. Here are some of the most important and recent methods.

Republic Steel Co. built a fluidized process plant at Toledo, Ohio, some years back. It's reported to be producing iron powder today.

Inland Steel Corp. is reported to have investigated fluidized solids as a direct reduction route in 1951. Results were not too good—the ore stuck in the reactor at the 850 deg C and atmospheric pressure conditions used. Sticking has been a major problem in most direct reduction attempts.

Hydrocarbon Research Inc. and Bethlehem Steel Co. found the clue to a fluidized approach and licked the sticking problem. They operated their reactor at a temperature of 900 deg F and under 250 psi, pressure substituting for temperature. Result was the H-Iron Process.

H-Iron uses natural gas or fuel oil to produce the hydrogen needed for the reaction. Hydrocarbon Research has its own generating process, a patented partial oxidation of natural gas or fuel oil. But any hydrogen source can be used. H-Iron is a batch method.

According to Russell MacMullan, H-Iron costs are independent of the state of reduction desired. It costs just as much to produce 70% reduced as it does to produce 95%. Production costs are estimated at $21.11 per ton produced on the East Coast using fuel oil as hydrogen source. In gas-rich Texas, the cost is estimated at only $13.60 per ton produced. Both estimates include write-off at 10% and profit at 15% per year.

We've made the following rough cost comparison based on iron ore at $11.70 per ton Lake Ports (51.5%

Krupp-Renn Used on Nonferrous Ores

Type of ore	Garnierite	Garnierite	Roasted concentrate
Composition	0.93% Ni 10.5% Fe 55.0% SiO_2 2.9% Al_2O_3 1.8% CaO 15.8% MgO 19.4% moisture	2.07% Ni 18.5% Fe 33.05% SiO_2 1.3% Al_2O_3 0.2% CoO 21.0% MgO 34.2% moisture	7.8% Ni 37.5% Zn 1.0% Pb 24.1% Fe 5.5% S 453 g/t Ag 3.7 g/t Au
Reducing fuel	coke breeze	coke breeze	coke breeze
Product	8.8% Ni nodules	9.2% Ni nodules	Zinc oxide with 74.7% Zn and 2.6% Pb, plus a luppen concentrate
Recovery	83% in the nodules	92% in the nodules	95% of the Zn and Pb in the zinc oxide, and better than 96% of the Cu, Ag and Au in the luppen concentrate

Fe). Assuming 1.8 tons of ore to make one ton 95% reduced iron, total cost from ore to metal would be in the neighborhood of $42.21 a ton, plus ore freight, on the East Coast ($34.70 in Texas). This is cheaper than pig iron at Pittsburgh, currently at $66 a ton. In fact, this is very close to No. 1 scrap at $34 a ton, f.o.b., Pittsburgh.

Published reports by Hydrocarbon Research say that hydrogen can be generated at from $4 to $8 a ton reduced iron by a variety of reforming methods from a wide range of raw materials.

H-Iron takes out some sulphur from normally low-sulphur ores. It can take sulphur down to 0.03% S. It can't touch phosphorus. Process hasn't been tried on a high sulphur tailing or residue, such as those huge piles at Trail, Flin Flon and Butte, but the company feels that the process could reduce these tailings, if the sulphur were removed to about 1% by conventional means (see flowsheet on p. 89).

Esso Research—A. D. Little Process is a gaseous reduction method that uses natural gas as a reducing agent. It differs from H-Iron in that some reduced iron must be present in the ore stream to crack the natural gas to form hydrogen and carbon monoxide, the reducing agents. This is a continuous process (see flowsheet on p 92).

Madaras Process was first piloted during Word War II at Longview, Texas. It is a batch process using steam to reform natural gas (page 91).

U. S. Steel—Dorr Oliver Process is a continuous gaseous reduction route. Hydrogen is under lower pressure than in H-Iron. A pilot plant is located at South Chicago, Ill. (page 90).

Cyclosteel Process, currently under pilot plant study in England, is a novel approach to the problem. Fine ground ore is fed with ground coal and air into a cyclone-inducing combustion chamber where the ore is reduced to molten iron and slag almost instantaneously. Process is at least ten years away from a commercial trial. See page 88.

National Lead Co. and Republic Steel Corp. have a process. R-N Corp. was formed to handle the pilot plant study. R-N Corp. states that this kiln process can produce 85- to 95% reduced iron, rejecting some 90% of the sulphur and phosphorus. R-N capital costs are estimated to be 50% of a blast furnace-open hearth of equal size. So far, over 50,000 tons of R-N Iron have been produced at the pilot plant in Alabama. R-N is much like Krupp-Renn, except the temperatures are lower (see p 92).

BRIQUETTED H-IRON can be produced at a cost competitive with present market price of No. 1 scrap or even pig iron in natural gas rich locations.

Krupp-Renn has been proven to be more economical as a kiln reducing method for iron ore fines than sintering. Krupp-Renn nodules make excellent blast furnace feed, according to Southwestern Engineering Co. Krupp used the process on nonferrous ores as well as iron. Please note the table on p 86 for results obtained with nickel ore and concentrate. Process has been adapted to the Renn-Waelz Process whereby reduced nonferrous ores are re-oxidized to volatilize off the lead, zinc or tin. See flowsheets on pages 90, 91 and 93.

Krupp-Renn rejects a high-sulphur slag, making high-sulphur ores suitable for electric furnace or open hearth feed. Southwestern Engineering made some cost estimates based on German machinery and methods. Capital cost is 80- to 110 Deutsch Marks (four for each $US) per ton annual ore feed. Operating costs, said to be below blast furnace costs, can be calculated from these German figures:

Required	Per ton ore treated
Man hours	0.5 to 1.5
Fuel oil	240 to 430 kg
Electricity	35 to 59 kwh
Repair parts, etc.	3 to 6 DM

Wiberg-Soderfors Process is probably the most successful operating process to date. It is a gaseous reduction technique using a shaft furnace. It is economic in Sweden. But certain ores are reportedly not hard enough to be used in the furnace. Soft ores tend to crush in the reduction zone and plug the furnace. Wiberg has the lowest energy demand per ton iron produced of any known process—only 9.2-million Btu as against 11- to 13-million Btu for a blast furnace, the next cheapest method. Flowsheet on p 93.

Domnarfvet kiln is used at Stora Kopparsberg Bergslags AB, Domnarfvet, Sweden to magnetically roast hematite for further concentration by magnetic separation. Iron recovery is 95% (see p 88).

Norsk-Stall Process uses a shaft furnace and reformed methane to reduce the ore. This is a batch process. Please see p 89.

We would like to acknowledge the fine work done by S. G. Cope in his "Reduction of Iron Ores—the Possibilities of an Alternative to the Blast Furnace" as published in the *Murex Ltd. Review,* Essex, England. Much of our background information was drawn from this source. Mr. Cope lists several other shaft furnace processes—Bassett, Sturzelberg, Humboldt, Weber and one currently under study by the Organization for European Economic Cooperation. He points out that over 240 direct reduction processes were patented in the U.S. alone up to 1951. Mr. Cope added details of these other processes:

(Continued on next page)

Sieurin or Höganas Process uses a stationary kiln with coke, ore and limestone batches reacted together at 1,200 deg C for 3½ days, then cooled to 150 deg C slowly. Result is a sponge iron assaying 94% Fe. Sponge is used in Sweden as a melting stock and is also exported as powdered metal stock. Plant capacity is 25,000 tons a year. Another plant is under construction.

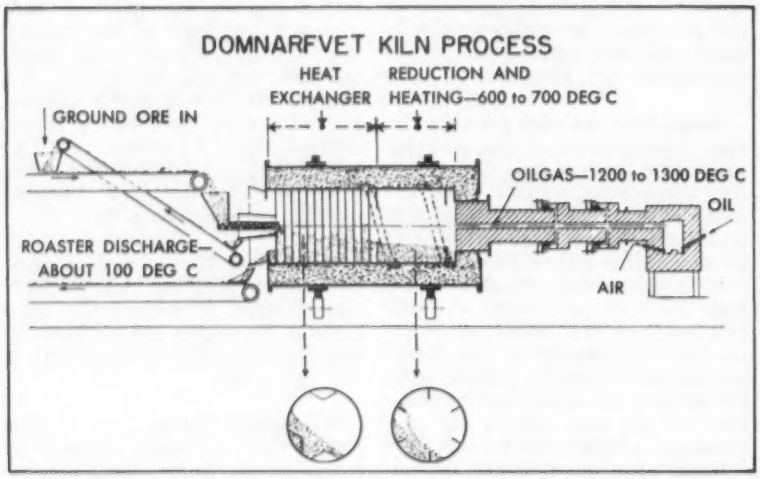
Monterrey Process takes its name from its location—Monterrey, Mexico. It is a stationary kiln process used to produce 600 to 800 tons of sponge iron melting stock each month.

Cape-Brassert Process was a wartime experiment by Republic Steel at Warren, Ohio, to produce a melting stock containing oxygen. Nichols-Herreshoff roasters were used. Plant produced metal, but never at design capacity and the experiment was soon abandoned.

Other sources used for background information were: U.S. Bureau of Mines publications, Dr. Bruce S. Olds' "Processes for Direct Reduction of Iron", Southwestern Engineering Co.'s literature, data furnished by those U. S. companies having direct reduction processes, and "H-Iron Process" by A. M. Squires and C. A. Johnson, Hydrocarbon Research Inc.

On the following pages, flowsheets of many processes mentioned above are shown with process data as available. It will come, not as a replacement for multi-million dollar blast furnaces already in operation, but for new installations, expansions in local markets or underdeveloped areas of the world. Each method has its advantages and disadvantages. None is a cure-all for the blast furnace—the work horse of the iron and steel industry.

Processes Developed, Methods Tested



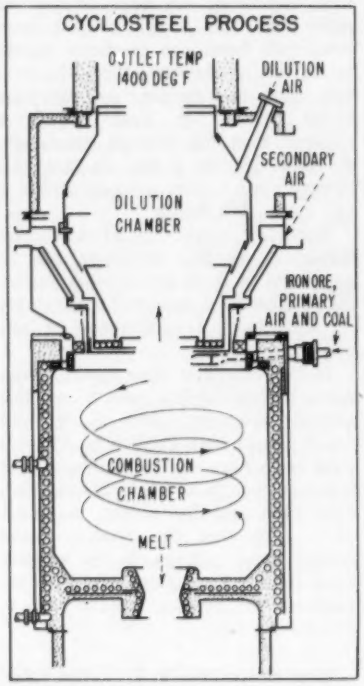
MAGNETIC ROASTING of hematite in a Domnarfvet kiln, cooling, and magnetic separation provides a high-grade slightly reduced furnace feed. Kiln is 750 mm inside dia, with a 1000-mm heat-exchanger section and an 800-mm reduction zone.

Kiln has been in operation since February 1957 on Norberg and Blotberget ores with very good results. Kiln capacity is 250 kg/hour.

Hematite ore enters the kiln in the central compartment of the heat-exchanger section where it is heated to near 700 deg C by heat from reduced ore passing outward in the outer compartments. In the reduction zone, ore is reduced by direct-fired oil burners at 1100 to 1300 deg C. Iron content of the tailings from the process after magnetic separation of the roasted product has been running about 9% Fe on Norberg ore and 5% on Blotberget. Iron recovery is 95%.

New furnace with a longer reducing zone and an air inlet at the charge-discharge end of the kiln is under construction. With this change, Stora Kopparsberg AB, Domnarfvet, Sweden, hopes to reach 97% or better iron recovery.

It has been suggested that an electric heater be added to the final reduction zone to carry out further reduction. Sulphur pickup is reportedly high, and attempts to reduce it by lime addition to the feed have not been successful due to the low melting point of the silicates. Process is relatively free from sticking problem.



NEWEST direct reduction process is in the pilot plant stage in England, according to reports from the British Iron and Steel Research Association. Cyclosteel Process is just the opposite of Bessemer practice—here, coal, air and iron ore are blown into a combustion chamber.

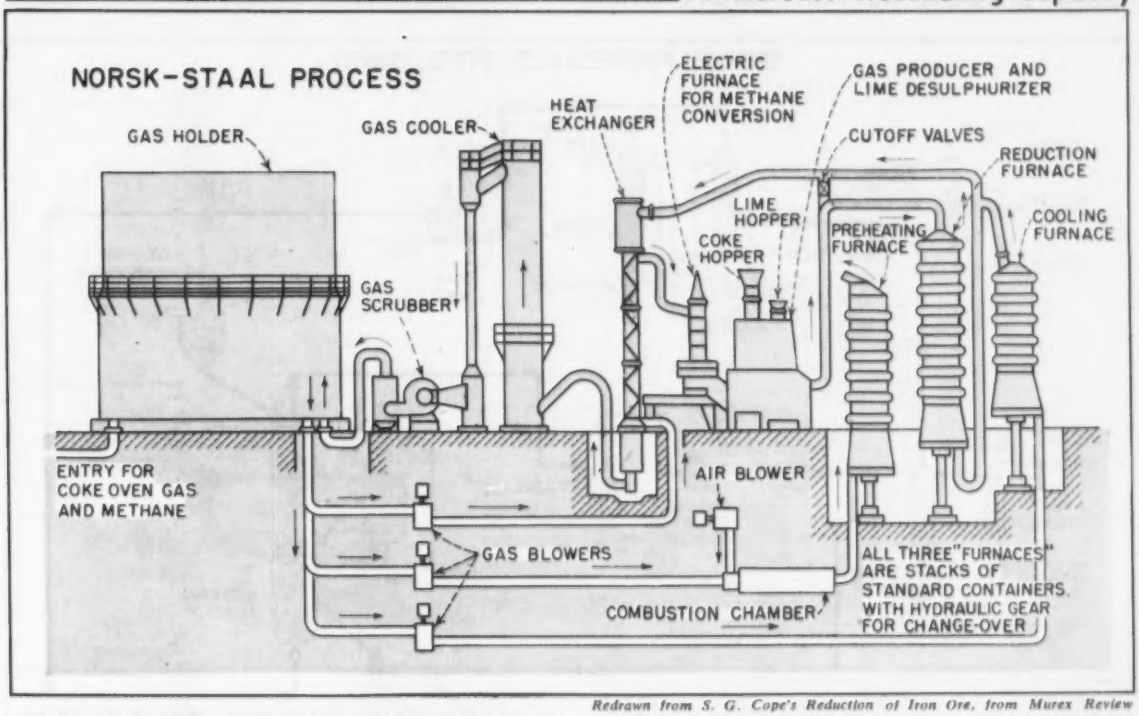
Perhaps it will take ten years to complete the development, but present feeling is that the method may well bypass the blast furnace, pig iron, sintering, coke ovens, and even possibly do away with pelletizing.

Cyclonic chamber is a converted coal burner designed by the British Coal Utilization Research Association. In the process, finely ground coal and ore are admitted tangentially into the combustion chamber, forming a cyclone-like turbulence. High particle speed and large surface area of the finely ground particles makes reduction almost instantaneous.

As reaction proceeds, iron ore is smelted into pig iron and a slag, formed by the natural gangue elements, spirals down the chamber into a holding pot below.

By proper control of jacket temperature, a slag lining can be built up on the chamber walls. So far tests have been on low-sulphur coals and ores. Phosphorus and sulphur assays of the product resemble blast furnace pig iron.

Pilot plant was to be a two-stage affair. Finely ground ore was to be partially reduced with coal and made sticky in a FluoSolids reactor.

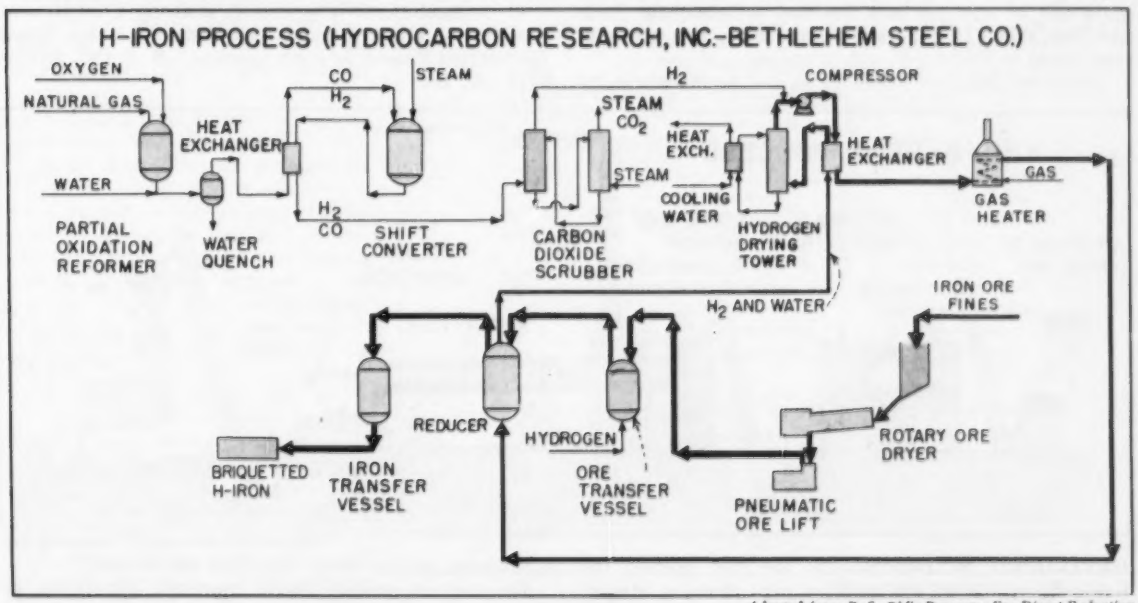


Redrawn from S. G. Cope's Reduction of Iron Ore, from Murex Review

AN INTERESTING modification of the shaft furnace with the object of avoiding difficulties of crushing or agglomerating and subsequent stoppage of gas flow is to be found in the Edwin or Norsk-Staal Process. Ore was placed in squat, cylindrical containers, each with a perforated fireclay bottom, and designed to fit one-on-top-of-the-other to form a shaft furnace.

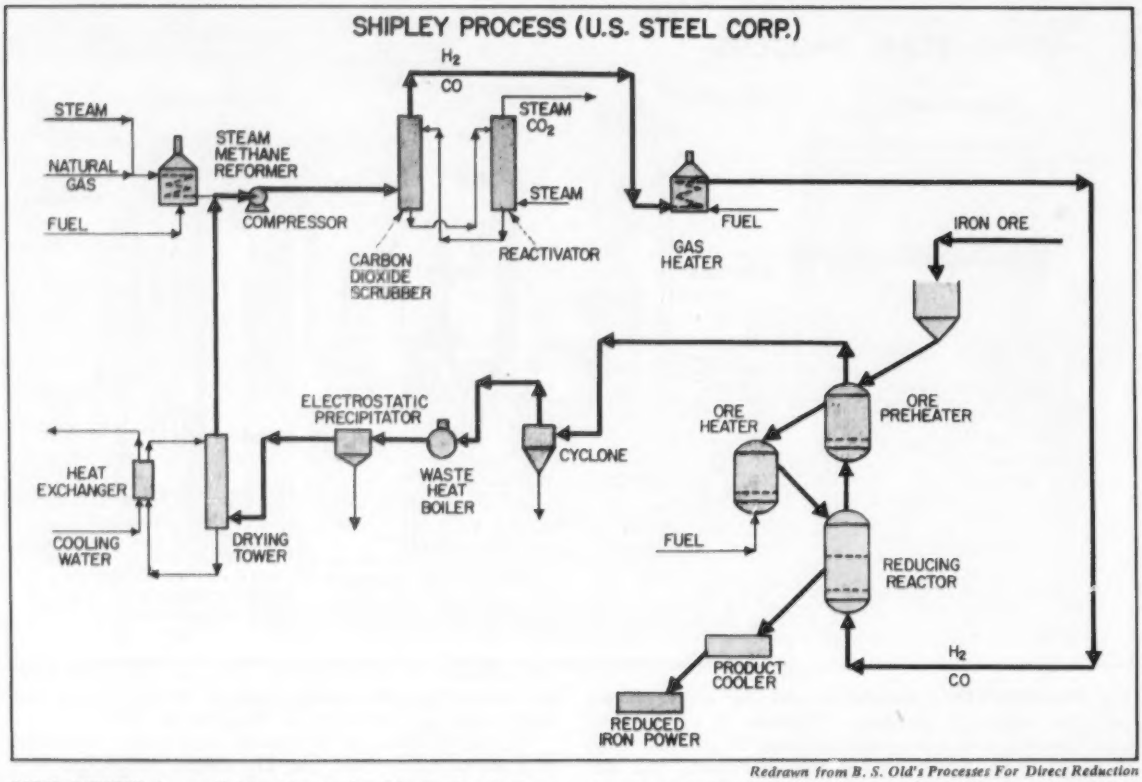
Pots are set in three columns, one for preheating, one for reduction and the third for sponge cooling. Norsk-Staal plant went into operation at Bochum in 1930.

Gas passed through an electric tube heater converting methane to CO (55%) and H_2 (40%), which was then desulphurized. Containers were moved every 1½ hours and a fresh container was put on the top of the preheat column. Some of the briquetted ore disintegrated and made the charge impervious to gas flow.—from S. G. Cope.



Adapted from B. S. Old's Processes For Direct Reduction

IN THE PROCESS, fine ground iron ore is kiln-dried at 900 deg F, then fed to a reactor where reduction with dry H_2 produces reduced Fe, water and unreacted H_2. Reduced iron is compacted into briquettes. Unreacted hydrogen is reclaimed, redried and recycled. Hydrogen is produced using Hydrocarbon's patented partial oxidation method, although any reforming, oxidation or gasification process can be used on any fuel—methane, coke breeze, coke oven gas, cat reform gases, fuel oil, coal, etc. Alan Wood Steel will be the first to build such a plant.

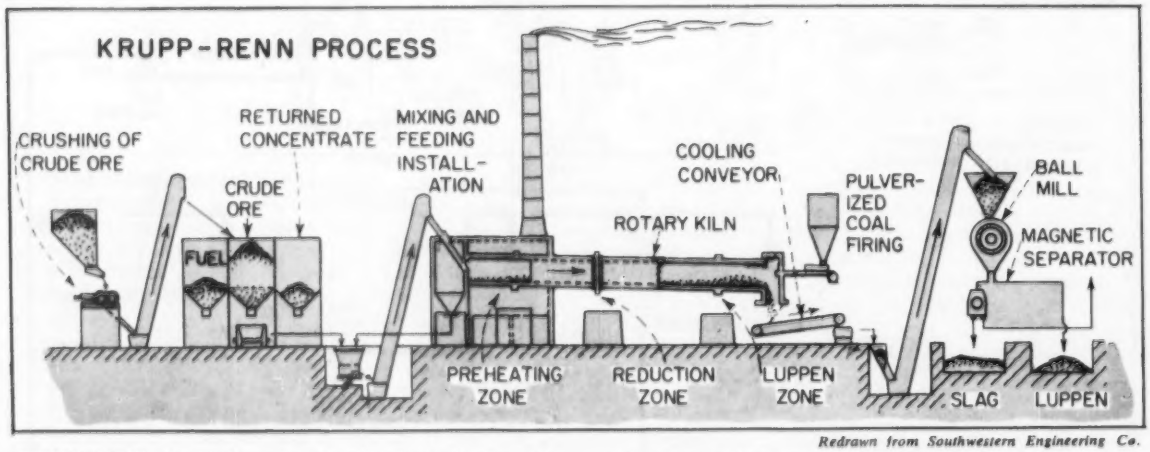


Redrawn from B. S. Old's Processes For Direct Reduction

NOT MUCH is available about the U. S. Steel Corp. process other than that available from the Shipley patent. Dorr-Oliver Inc. has been working with USS at a pilot plant in South Chicago, Ill. Process is a continuous gaseous reduction of iron ore in a fluidized column. High-grade ore fines, minus ¼ in., are fed continuously to a preheater and raised to 700 deg F with waste gas.

Preheated ore then passes to an ore heater where the temperature is raised to 1700 deg F by the combustion of natural gas. Under these conditions, gas-solids contact and hydrogen reduction produces a reaction that goes to equilibrium in ½ to 2 seconds.

U. S. Steel Corp. is reportedly studying a mixture of CO and H_2 as a reductant. This method has been called the Nu-Iron Process in some quarters.—B. S. Old, Arthur D. Little, Inc.



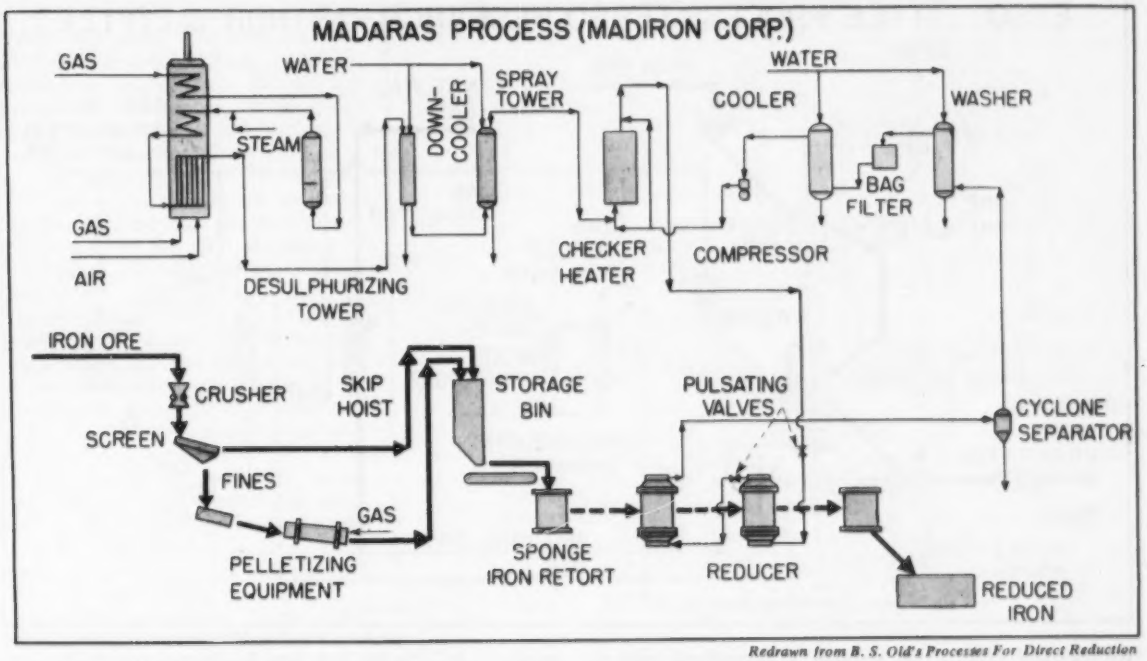
Redrawn from Southwestern Engineering Co.

DEVELOPED by Johannsen in the late thirties, the Krupp-Renn Process was tested in pilot plants at Magdeberg and Borbeck. Process is carried out in a rotary kiln as a reduction process intended to produce iron in the form of low-carbon metallic nodules called luppen.

As regards fuel, it offers a great advantage that it is not dependent upon the use of large-scale metallurgical coke installation, and almost any fine-grained solid fuel can be used—even inferior coals with high ash content.

Krupp-Renn permits direct, economic conversion of low-grade or even high silica ores with iron recoveries of 90 to 97%. Metallic luppen is free from gangue. This is not a sponge iron process.

After preheating by waste gases at 1100 deg F, reduction takes place at 2000 deg F, then the luppen is formed by agglomeration at 2300 to 2800 deg F.



Redrawn from B. S. Old's Processes For Direct Reduction

THIS IS A BATCH retort process using steam to reform natural gas as a reducing agent for the iron ore. Ore is fed to the reactor in fairly coarse sizes with oversize crushed to minus 2 in. and minus ¼ in. pelletized before addition.

Gas is preheated to 800 deg F, desulphurized and reformed with steam at 1500 deg F. Gas at 3:1 H_2 to CO ratio is heated in checkerworks to 1800 deg F., then fed to a brick-lined retort holding 16 tons of ore.

Ore charge is preheated to bring it up to correct temperature (1600 to 1800 deg F). Total heating time is five hours. Gas enters the retort at 25 psi and is pulsated about 21 times a minute by means of a butterfly valve in the line. Madaras plant is at Longview, Texas.

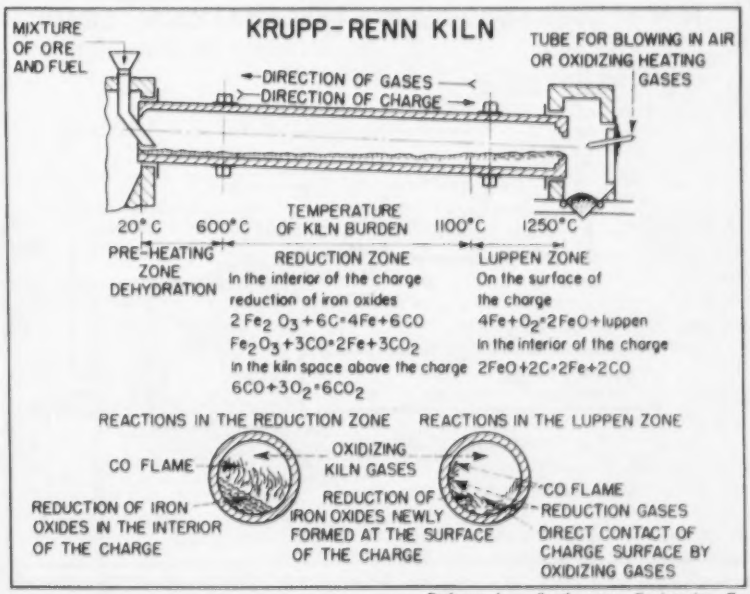
FEED TRAVEL is continuous, countercurrent to the gas flow in a Krupp-Renn kiln. After preheating with waste gas, reduction of iron oxides to sponge iron takes place at temperatures ranging from 600 to 1100 deg C as shown in the drawing.

In the last or luppen zone of the kiln, iron sponge welds together to form luppen, which remains distributed in the pasty slag and is discharged with it. An additional heating system is required to control the process. This is provided by a pulverized coal or fuel oil burner.

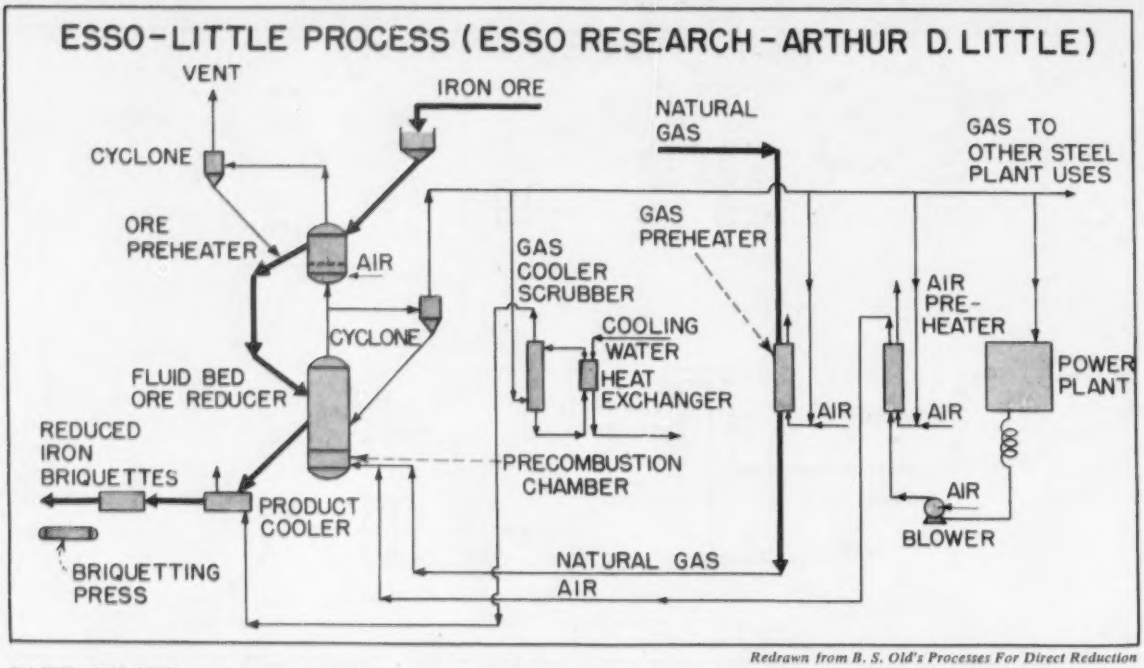
Cooled furnace discharge is crushed, screened and separated magnetically into luppen, slag and a middling which is recycled. Luppen, ranging in size from 0.6 to 2 in. dia, is practically slag free, and forms a good low-carbon product which readily lends itself to the production of pig iron, commercial or alloy steel.

In the reduction zone, each discriminate iron oxide particle remains finely distributed in the gangue after conversion to iron. In the luppen or last kiln zone, the level of the charge is raised, and the charge remains in this zone for several hours. Toward the end of the cycle, the surface of the iron sponge begins to fuse, then the slag segregates, leaving a skeletal structure behind which welds together other iron particles to form the luppen or nodules.

Some iron is oxidized back to the oxide and vice versa. Waste kiln gas leaves the kiln at 400 deg C and goes to the ore preheater. According to Southwestern Engineering Co., the Krupp-Renn Process makes excellent use of the sensible heat of reaction.


KRUPP-RENN KILN
MIXTURE OF ORE AND FUEL
TUBE FOR BLOWING IN AIR OR OXIDIZING HEATING GASES
DIRECTION OF GASES
DIRECTION OF CHARGE
TEMPERATURE OF KILN BURDEN
20° C
600° C
1100° C
1250° C
PRE-HEATING ZONE DEHYDRATION
REDUCTION ZONE
In the interior of the charge reduction of iron oxides
$2Fe_2O_3+6C=4Fe+6CO$
$Fe_2O_3+3CO=2Fe+3CO_2$
In the kiln space above the charge
$6CO+3O_2=6CO_2$
LUPPEN ZONE
On the surface of the charge
$4Fe+O_2=2FeO$ + luppen
In the interior of the charge
$2FeO+2C=2Fe+2CO$
REACTIONS IN THE REDUCTION ZONE
REACTIONS IN THE LUPPEN ZONE
CO FLAME
OXIDIZING KILN GASES
REDUCTION OF IRON OXIDES IN THE INTERIOR OF THE CHARGE
REDUCTION OF IRON OXIDES NEWLY FORMED AT THE SURFACE OF THE CHARGE
CO FLAME
REDUCTION GASES
DIRECT CONTACT OF CHARGE SURFACE BY OXIDIZING GASES

Redrawn from Southwestern Engineering Co.

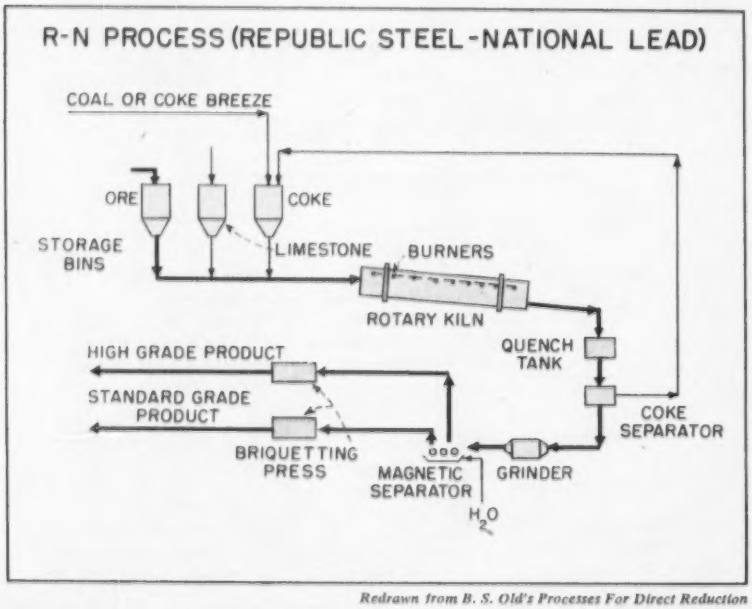


Redrawn from B. S. Old's Processes For Direct Reduction

BASED ON THE partial combustion of methane with air to CO and H_2, the Esso Research—A. D. Little Process is a simple continuous direct reduction process operating at near atmospheric pressure. Methane is partially burned to heat the reaction, then the methane is cracked by the presence of metallic iron powder in the feed to CO and H_2 which reduce the iron oxides.

Air is preheated to 1500 to 1600 deg F and the methane to 600 to 700 deg F. Partial reduction then takes place. Ore, mixed with powdered iron, is fed to a fluidized preheater where the temperature is raised to 1500 to 1600 deg F. Preheated ore passes by gravity through two or three reducing, fluidized beds. Off gases are not recycled in this process, but are cleaned in a dust collector and used to preheat fresh reactants.

Reduced iron is cooled with cold off gases. B. S. Old.



Redrawn from B. S. Old's Processes For Direct Reduction

DEVELOPED by National Lead Co. and Republic Steel Corp., the R-N Process has successfully reduced a wide range of magnetic and nonmagnetic ores. R-N Corp., a joint subsidiary, says that the process will make available large tonnages of low-grade ores not now economic, and that the process can be used to upgrade high quality ores. Product of the reaction are briquettes, a substitute for No. 1 scrap. Process can use any low-grade fuel — chars from noncoking coals, coke breeze, etc.

Semi plant with 175 tpd ore feed capacity has been in operation at Birmingham, Ala. for the past two years. Over 50,000 tons of iron, running 85 to 95% Fe and less than 1% SiO_2, have been made. Process recovers 90% of the Fe, while rejecting up to 90% of the S and P on some ores. R-N Corp. states that a greater range of fuels and ores are possible on R-N than with any other method.

R-N is a kiln process. Ore is sized near 1 in. to 14 mesh. Limestone is added along with a reducing agent such as coke breeze, anthracite fines, lignite or char, and the blend fed to a 9 ft dia by 150 ft kiln. Temperature is held below sinter point during the reduction step, then the kiln discharge is quenched and any unburned carbon recovered.

Cooled discharge is ground and passed over magnetic separators to recover the iron which is briquetted. If high-grade (50% Fe) ore is used, a 90% Fe product can be made. If low-grade ore is used, two products are obtained: a high-grade, 90% Fe open hearth or electric furnace feed, and a low-grade, 70% Fe blast furnace feed.

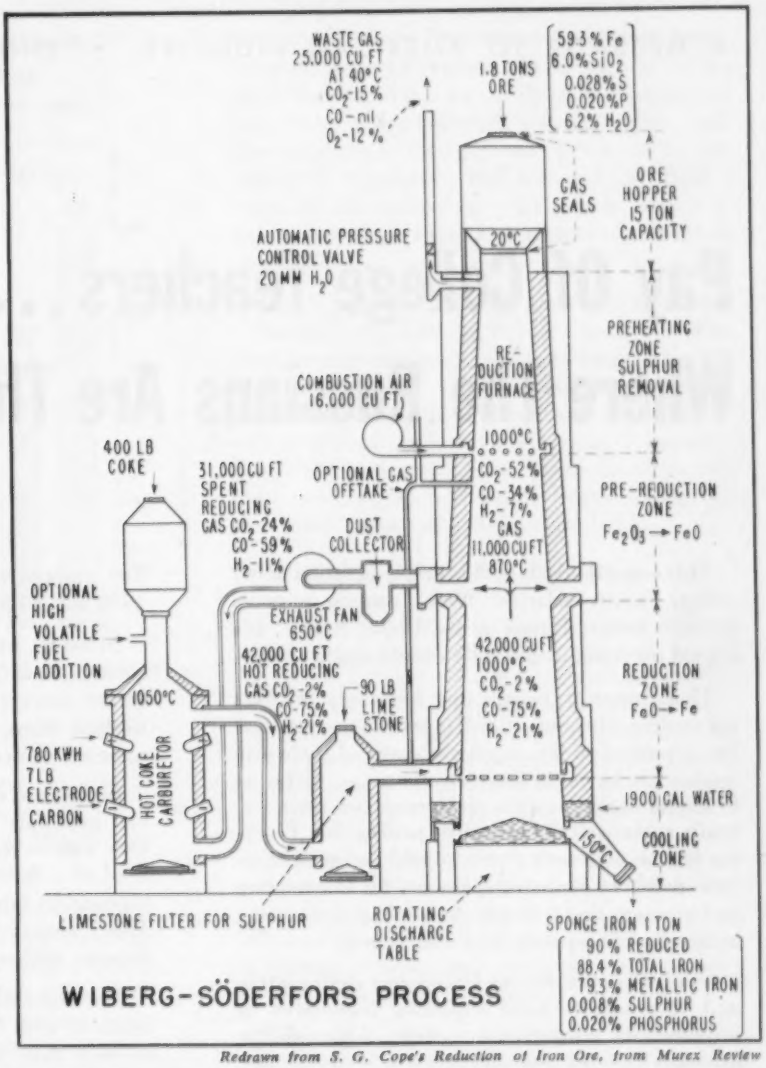
ONE OF THE MOST SUCCESSFUL reduction processes is the Wiberg-Soderfors Process which is producing sponge iron for electric furnace use in Sweden. In the process, a hot mixture of CO and H_2 is produced from coke in a special form of an electrode-heated carburetor. Hot gas is passed through limestone to filter out sulphur and then enters the bottom of the shaft furnace.

Passing upwards, the gas reduces descending iron oxides until it reaches a point about halfway up the shaft. At this point, part of the gas, depleted of CO and H_2, is removed from the furnace and returned to the carburetor, while the remainder proceeds up the shaft, carrying out preliminary ore reduction.

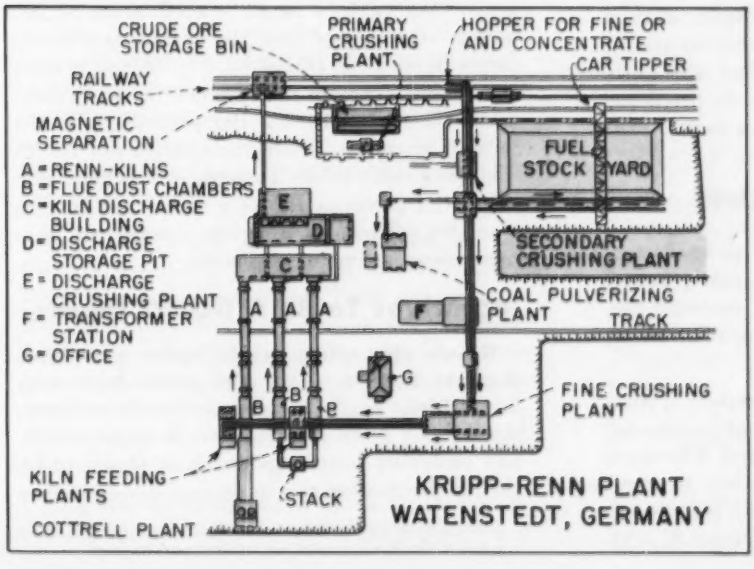
Still further up the shaft, air is admitted to burn combustible gases and preheat incoming ore. In the preheating zone, heat transfer is excellent, as the top gases are almost cold and the ore reaches 1000 deg C in the pre-reduction zone. In the latter zone, the predominant reaction is the slightly endothermic reduction of ferric to ferrous oxide, and the temperature drops to about 870 deg C.

In the final reduction zone, exothermic reaction to metallic iron raises the temperature of the sponge to about 1000 deg C. Providing the temperature does not rise any higher, sticking does not appear to be a serious problem. Reduced iron is cooled and discharged at about 150 deg C into airtight shipping containers.

Furnace capacity is 90 tons of ore. Nominal output is 60 tpd. Quantities shown on drawing are for one ton of sponge from Canadian Steep Rock iron ore.—according to S. C. Cope.


WASTE GAS 25,000 CU FT AT 40°C CO_2-15% CO-nil O_2-12%
1.8 TONS ORE
59.3% Fe 6.0% SiO_2 0.028% S 0.020% P 6.2% H_2O
GAS SEALS
ORE HOPPER 15 TON CAPACITY
AUTOMATIC PRESSURE CONTROL VALVE 20 MM H_2O
20°C
PREHEATING ZONE SULPHUR REMOVAL
RE-DUCTION FURNACE
COMBUSTION AIR 16,000 CU FT
400 LB COKE
31,000 CU FT SPENT REDUCING GAS CO_2-24% CO-59% H_2-11%
OPTIONAL GAS OFFTAKE
1000°C CO_2-52% CO-34% H_2-7% GAS 11,000 CU FT 870°C
PRE-REDUCTION ZONE $Fe_2O_3 \rightarrow FeO$
DUST COLLECTOR
OPTIONAL HIGH VOLATILE FUEL ADDITION
EXHAUST FAN 650°C
42,000 CU FT HOT REDUCING GAS CO_2-2% CO-75% H_2-21%
90 LB LIME STONE
42,000 CU FT 1000°C CO_2-2% CO-75% H_2-21%
REDUCTION ZONE FeO → Fe
1050°C
780 KWH 7 LB ELECTRODE CARBON
HOT COKE CARBURETOR
1900 GAL WATER
150°C
COOLING ZONE
LIMESTONE FILTER FOR SULPHUR
ROTATING DISCHARGE TABLE
SPONGE IRON 1 TON 90% REDUCED 88.4% TOTAL IRON 79.3% METALLIC IRON 0.008% SULPHUR 0.020% PHOSPHORUS
WIBERG-SÖDERFORS PROCESS

Redrawn from S. G. Cope's Reduction of Iron Ore, from Murex Review



IN 1934, Krupp built a Krupp-Renn Process plant to convert nickel-bearing garnierite to nickel-bearing nodules. Plant ran from 1935 through 1945, with a second kiln (11.8 ft dia by 164 ft) added in 1942. Plant was dismantled and moved to USSR in 1945.

A Krupp-Renn plant was erected in 1941 to 1944 at Salzgitter-Watenstedt with three 13.7 ft dia by 230 ft kilns. First kiln went into operation in 1944, the second in late 1944, and the third never did get finished due to the ending of the war. Daily output met design capacity of 500 tpd ore per kiln. Iron was recovered in the form of luppen (nodules) containing 92 to 96% iron from poor-grade Salzgitter ore. After the war the plant was dismantled.

In addition to these plants which were erected, Krupp built 16 plants for the Far East.

Pay Of College Teachers... Where The Russians Are The Capitalists

This editorial deals with a simple question about college faculty salaries: Which country pays its teachers better, Russia or the United States? It's a good question, with a sadly embarrassing answer.

That American college and university teachers are underpaid is not a novel observation. But what has happened to the economic status of their profession can be put in more candid terms. **As far as financial incentives are concerned, we have virtually socialized the academic profession.** Teaching has become such a poorly paid career, with so little prospect of material reward for outstanding performance, that it simply does not attract enough highly qualified young men and women.

Ironically, the Soviet Union has deliberately and successfully used capitalist incentives to improve its educational system. Although the Russians show an utter disregard of civil liberties, they pay their teachers well and confer on them all the prestige and privileges the Soviet society can offer. Russian professors, together with party officials and scientists, have become the privileged upper class of a supposedly classless society.

Incentives To Be A Teacher

To be a college teacher requires high intellectual competence and long, sometimes costly, formal training. Aside from the appeal of academic life, what incentive does college teaching offer bright young men and women?

In the U. S., the average faculty salary is little more than the average income of industrial workers. According to the National Education Association, the average faculty salary is about $5,240. College instructors receive $4,100, associate professors $5,730 and full professors $7,100. The average income of U. S. factory workers in 1956 was $4,580.

Actually, workers in many industries — steel, automobile and petroleum, for example—earn more on the average than college teachers. And skilled workers often earn more than full professors at some of our colleges and universities.

In Russia, on the other hand, the young Soviet graduate can see that it pays — and pays very well — to choose teaching as a career. The head of a department in a Russian university can command a salary of about 6,000 rubles a month.* This is about eight times the income of the average Russian worker, who earns 750 rubles a month.

The Russian professor comes off very well in terms of what his income will buy. It has been estimated that, based on Soviet consumption patterns, 6,000 rubles a month is worth about $7,200 a year — or higher than the average professor's salary in the U. S. Of course, it is difficult to compare living standards in two countries as different as the U. S. and Russia. But particularly in the field of science — where the salaries can run to 15,000 or more rubles a month — it is clear that the Soviet professor enjoys a higher real income than that offered his American counterpart by a much more prosperous economy.

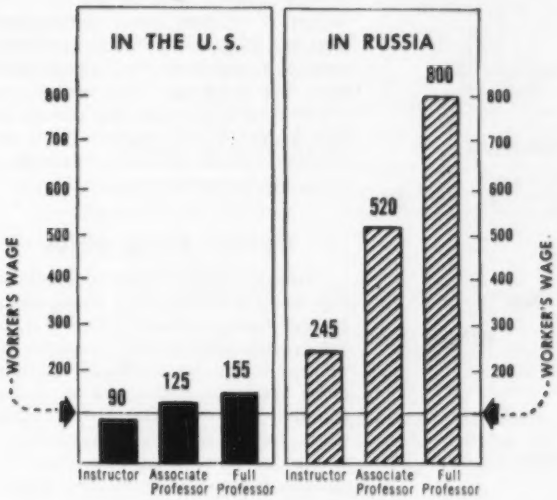
Incentives To Be A GOOD Teacher

Russia also offers much higher premiums than the U. S. to those who attain distinction in teaching. Teachers at the university level earn significantly more than teachers in high schools, and university instructors can look forward to a sharply progressive rise in earning power as they

* *Soviet Education for Science and Technology* by Alexander Korol of the M.I.T. Center for International Studies.

How Faculty Salaries Compare With Industrial Wages

(Worker's Wage In Each Country = 100)



*Sources: Center for International Studies, M.I.T.; National Education Association; McGraw-Hill Department of Economics

advance to higher positions. The spread between the income of a full professor and the lowest academic position is greater than fifteen to one. In addition, full professors can earn a healthy bonus if they are elected to membership in the Russian Academy of Sciences.

In the U. S., by contrast, full professors on the average earn less than twice as much as beginning instructors. And many college professors earn less than public school teachers in large cities. Even a full professor's pay does not compare with earnings in other professions or in positions in industry requiring similar training. The point was well summarized in a recent speech by Marion B. Folsom, Secretary of Health, Education and Welfare: "It is nothing short of a national disgrace that we are discouraging people who want to teach by offering salaries that are far below the levels justified by their training and far below the levels which others are willing to pay."

Our colleges and universities, as well as our teachers, find themselves in a serious predicament. Faced with a shortage of both funds and teachers, they cannot reward distinguished performances. Limited resources for salary increases have gone predominantly to the lower ranks, so that an adequate number of teachers could be retained. Meanwhile, potentially fine teachers are being siphoned off into better paid occupations.

The shabby treatment of our teachers threatens to undermine, not only our educational standards, but our free enterprise system itself. There is the recent example of a liberal arts college which discovered that five of its graduating seniors were being offered starting salaries higher than those paid any of their professors. It would be surprising if experiences like this did not place a strain on the enthusiasm with which these professors deal with some key aspects of American capitalism.

Also important is the role education is playing in the cold war with the Soviet Union. The Russians have made great strides in raising the quality of their education — particularly in science and engineering. Both the number and the technical calibre of their graduates are impressive, as recent Soviet achievements testify. These successes owe much to the generous economic treatment the Russians have given their teaching profession.

A Standard For Faculty Pay

Earlier editorials in this series have outlined various ways American business can help relieve the financial plight of our colleges and universities. They have suggested that private contributions to higher education should average at least $400 million a year over the next ten years if faculty salaries are to be raised to adequate levels and our colleges are to be able to meet increasing operating costs.

Another standard for raising faculty salaries proposed by an American businessman is this: "When a teacher's income gets up to a point where you will suggest to your boy that he ought to give some thought to teaching as a profession, then we may be approaching the right figure."

Russia clearly has set her teaching salaries well above the "right" figure. We are nowhere near it. What this adds up to is that the Communists — not we — have become the shrewd capitalists in the vital field of education.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C. McGraw
PRESIDENT

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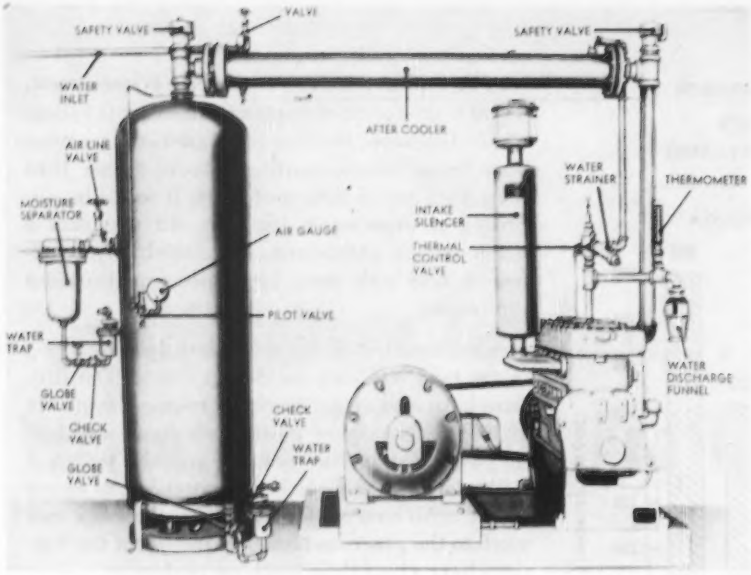


MOISTURE IS ELIMINATED in this well designed system. Aftercooler, located between compressor and receiver, causes most of water to fall out in receiver. This leaves less for separator, at receiver outlet, to remove before air enters line.

Use These Suggestions For Dry Compressed Air

A. N. GUSTAFSON

WET COMPRESSED AIR is an expensive nuisance. It can rust air tools and cause excessive wear by washing off lubricating film from wearing surfaces. It carries dirt and sediment through pipes and collects in low spots causing water hammer, which jars loose scale, rust and dirt. When exposed to freezing temperatures it can plug or even burst piping.

How water gets into compressed air lines and how it can be kept out are questions that are important to mine operators because of the wide use of air as power. It is becoming increasingly important with the growing applications of air to tools, machines and controls of all types.

All atmospheric air contains some moisture. Air's ability to retain vaporized water increases as temperature is raised and decreases as it is lowered. Pressure has the opposite effect. In this respect it is like a sponge—the harder you squeeze it, the less water it can hold.

In a compressed air system, air enters at atmospheric temperature and pressure. Compressing it raises the temperature. This heat is dissipated to the surrounding atmosphere through the compressor walls, the pipes and the receiver and to the cooling water if an aftercooler is used. Temperature is further reduced during transmission and during expansion at point of use.

These changes in temperature and pressure are responsible for condensation in any compressed air system wherever it may be.

It can happen even in very dry climates. For example, if free air at 50% relative humidity—rather dry for atmospheric air—were compressed to 100 psi and cooled to room temperature, it would then have relative humidity of 400%. This is foggy and any further compression or cooling would precipitate water.

Moisture is more of a problem in humid climate. For a typical case, suppose that it is a hot, humid day—temperature 90 deg F and humidity is 80%. A compressor is delivering 200 cfm at 80-lb gage pressure. Each cubic foot of atmospheric air at these conditions contains 0.00175 lb of water. Since 200 cfm are drawn into compressor, total intake is 0.35 lb per minute. This wet air is then compressed to 80 psi.

Compression heats the air so much that it will carry all the moisture as suspended vapor. The full amount of water is therefore passed through the compressor. This warm air then cools in the receiver and in the air lines. When it reaches room temperature (90 deg F) it will be much more than saturated, and about 80% of the moisture will condense. This means that about 0.28 lb of water per minute, or two gal per hr will be deposited in the receiver and the air lines—enough to make the air really wet.

Correct Piping Helps

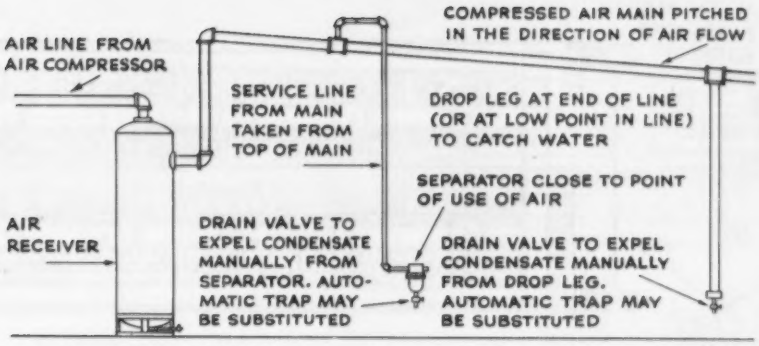
There are several ways to eliminate this water from air lines. In all cases, correct piping and draining will help. Where this alone is not adequate, aftercoolers can be employed to condense the water before the air is distributed. For unusual applications, where cooling water is not available or where air lines must pass outdoors through freezing temperatures, special desiccant dryers may be used.

One of the simplest and most effective ways to decrease air contamination and increase compressor efficiency is to locate the compressor intake carefully. For efficiency, the intake should preferably be outside the building, on the coolest side. Because this cool outside air is more dense than indoor air, a greater quantity of air will be delivered to the compressor. For example, only 943 cu ft of 40 deg F air will be needed to deliver the same weight as 1000 cu ft 70 deg F air—a direct saving of nearly 6%. The greater the differential between temperatures, the greater will be the economy.

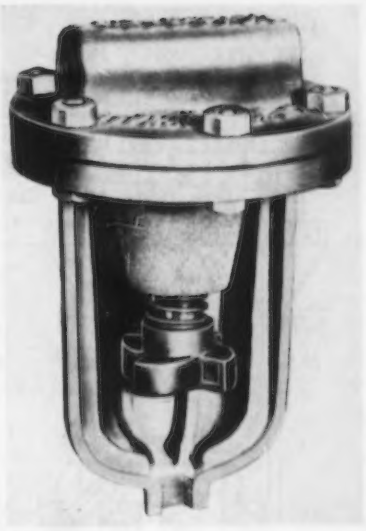
Care must be taken, however, to avoid locating the intake near steam or air exhaust vents, which would add moisture to the air. The location should also be free of dusts or any other source of contamination. Avoid sulphurous or chlorine-contaminated atmospheres—these substances mix with moisture to produce weak acids, which will attack screens, tools, and piping. Contaminants are also a ventilation hazard, especially underground.

If the receiver is the vertical type, air should enter at the top, so that moisture can fall directly to the bottom, where it will collect. The outlet from the receiver should be in the shell, near the top. A drain must be installed in the bottom of the receiver, and should be opened daily to remove all accumulated water. If automatic drainage is desired, an automatic trap can be used—preferably of the inverted bucket type. A similar arrangement should be used with horizontal

Mr. Gustafson is chief engineer of Schramm Inc., West Chester, Pa.


AIR LINE FROM AIR COMPRESSOR
COMPRESSED AIR MAIN PITCHED IN THE DIRECTION OF AIR FLOW
SERVICE LINE FROM MAIN TAKEN FROM TOP OF MAIN
DROP LEG AT END OF LINE (OR AT LOW POINT IN LINE) TO CATCH WATER
SEPARATOR CLOSE TO POINT OF USE OF AIR
AIR RECEIVER
DRAIN VALVE TO EXPEL CONDENSATE MANUALLY FROM SEPARATOR. AUTOMATIC TRAP MAY BE SUBSTITUTED
DRAIN VALVE TO EXPEL CONDENSATE MANUALLY FROM DROP LEG. AUTOMATIC TRAP MAY BE SUBSTITUTED

EVEN WITHOUT COOLING, proper piping and drainage can furnish reasonably dry air for less critical installations. Moisture separators are good at low points.



CYCLONE-TYPE moisture separator is very effective. Water is expelled through water traps and drain at bottom either automatically or manually.

receivers. The entrance should be at the head; the outlet should be in the shell, on the top side near the head. A bottom drain is also required.

Air lines must be large enough to handle demands from machines and services without excessive pressure drop (see table). These lines should be slightly pitched so that any moisture that condenses will flow in the same direction as the compressed air. At the end of the line, or at a low point in the line, a drop leg should be installed to collect condensate. Either a hand valve or an automatic trap can be used to drain this leg.

Service lines for tools or services should be taken from the top of the main. Any condensate in the main will flow by on the bottom. Use a check valve wherever there is any chance of liquids backing into the system from other sources, such as in air-purging systems. To remove any remaining water from the air before use, a moisture separator is usually installed in the service line immediately ahead of the point of use. The air will then be practically dry.

Cooling Is Very Effective

Completely dry air can be obtained by cooling it before distribution, to below lowest temperature encountered anywhere in system. The compressed air temperature below which water vapor begins to condense is called the dewpoint. If air is cooled below it water will be precipitated. The dewpoint will stay at lowest temperature to which air has been subjected provided that all released water has been trapped out. This water must be removed or it will vaporize again and raise the dewpoint.

An aftercooler can be used for this dewpoint reduction. It consists of a nest of tubes in a shell. Compressed air is passed through the tubes and cold water is circulated around them. Water flows through counter to air flow. Automatic valves may be used to control water flow. Discharge water can be used for compressor cooling since it is even better for this service than extremely cold water.

Air from the aftercooler enters the head of the receiver and the drops of water fall to the bottom where they are drained out. A thermometer in the cooler outlet permits the operator to make certain that the correct amount of cooling water is being used. For protection, a pop safety valve must be placed between the compressor and the aftercooler, or any possible source of obstruction in the air lines.

The proportions of a good aftercooler are such that the air will be cooled to within 10 deg F of the cooling water temperature with a flow of one to two gal. of water per minute for each 100 cu ft of air that is compressed to 100 psi. With an aftercooler designed according to this principle, water at 75 deg F or below would be adequate to completely dry the air in the previously described installation, where two gal of water per hr were condensed on a hot, humid day.

Any water carried through the receiver can be removed by a moisture separator. The type illustrated consists of a cylindrical chamber into which air flows tangentially, producing a swirling motion. The drops of water, which are heavier than air, are thrown to the walls of the chamber. From here they run down into the drain at the bottom of the separator, where they are expelled automatically by a trap, or manually by a valve. The air flows through a filter made of porous material which permits passage of air, but prevents passage of water and oil. Other separator designs are common too.

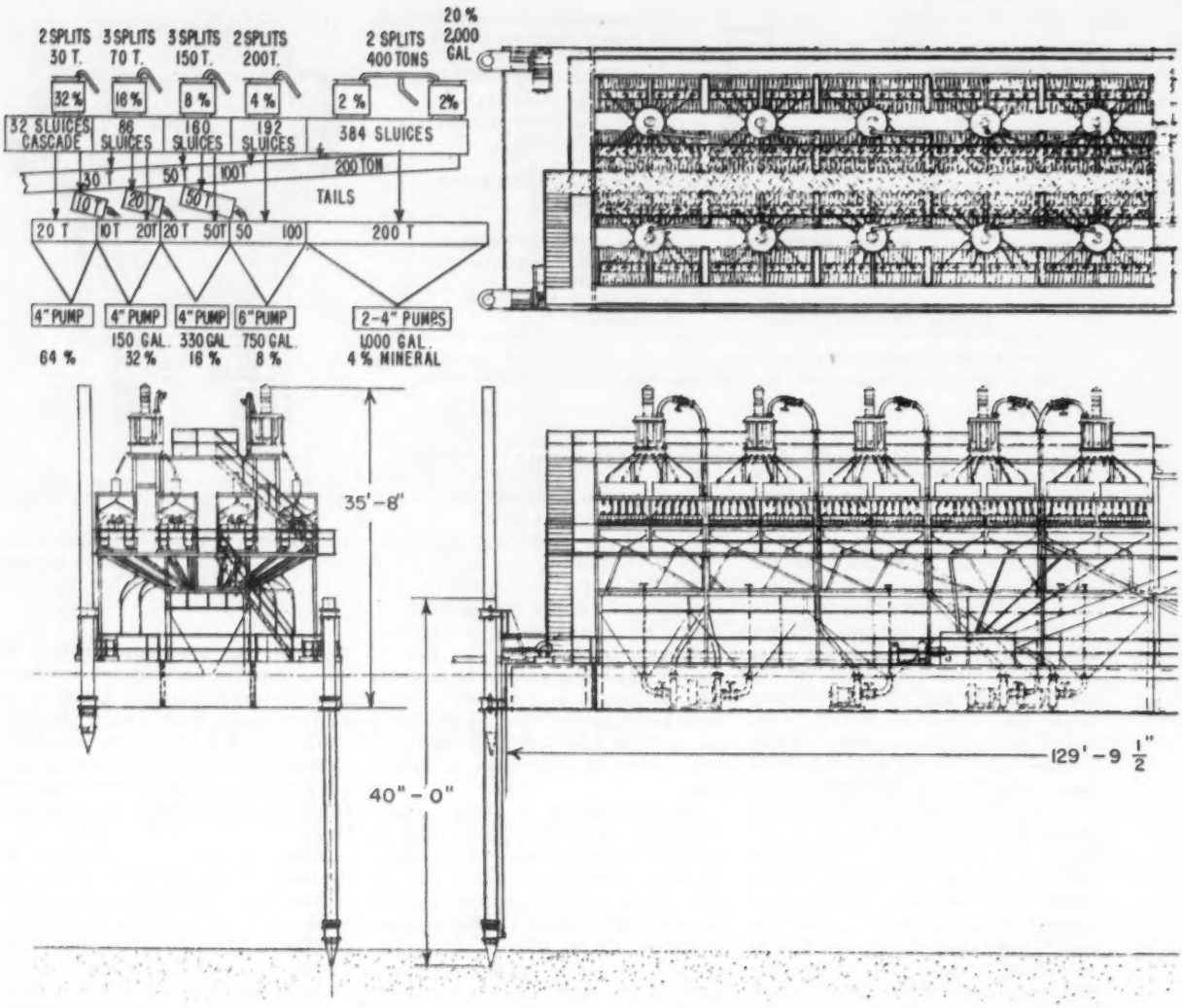
When the separator is located at the outlet of the aftercooler, it may be overburdened, for it will have to remove all of the moisture. It is better practice to place it in the line from the air receiver. When this is done, much of the moisture will first drop out in the receiver, leaving less work for the separator. The result will be drier air.

The common, locally-made water trap, simple baffle type, can be useful in long lines too.

By realizing these characteristics of compressed air, and by properly applying the drying techniques discussed here, it should be possible to eliminate costly water from practically any compressed air system.

Diameter Pipe For Less Than 1-lb Drop From 100-lb Gage

CFM Free Air	Length of Pipe in Feet										
	50	100	200	300	400	500	750	1000	2000	3000	5000
	Diameter in Inches										
20	¾	¾	¾	1	1	1	1	1¼	1¼	1¼	1½
60	1	1	1¼	1¼	1¼	1½	1½	2	2	2	2½
100	1¼	1¼	1½	1½	2	2	2	2	2½	2½	3
150	1¼	1½	2	2	2	2	2½	2½	3	3	3½
200	1½	2	2	2	2½	2½	2½	3	3	3½	3½
300	2	2	2½	2½	3	3	3	3	3½	4	5
500	2	2½	3	3	3	3½	3½	4	5	5	5
1000	3	3	3½	4	4	5	5	5	6	6	8



HOBART BROS. of Troy, Ohio, designed and built the above floating dredge and concentrating plant which upgrades a feed

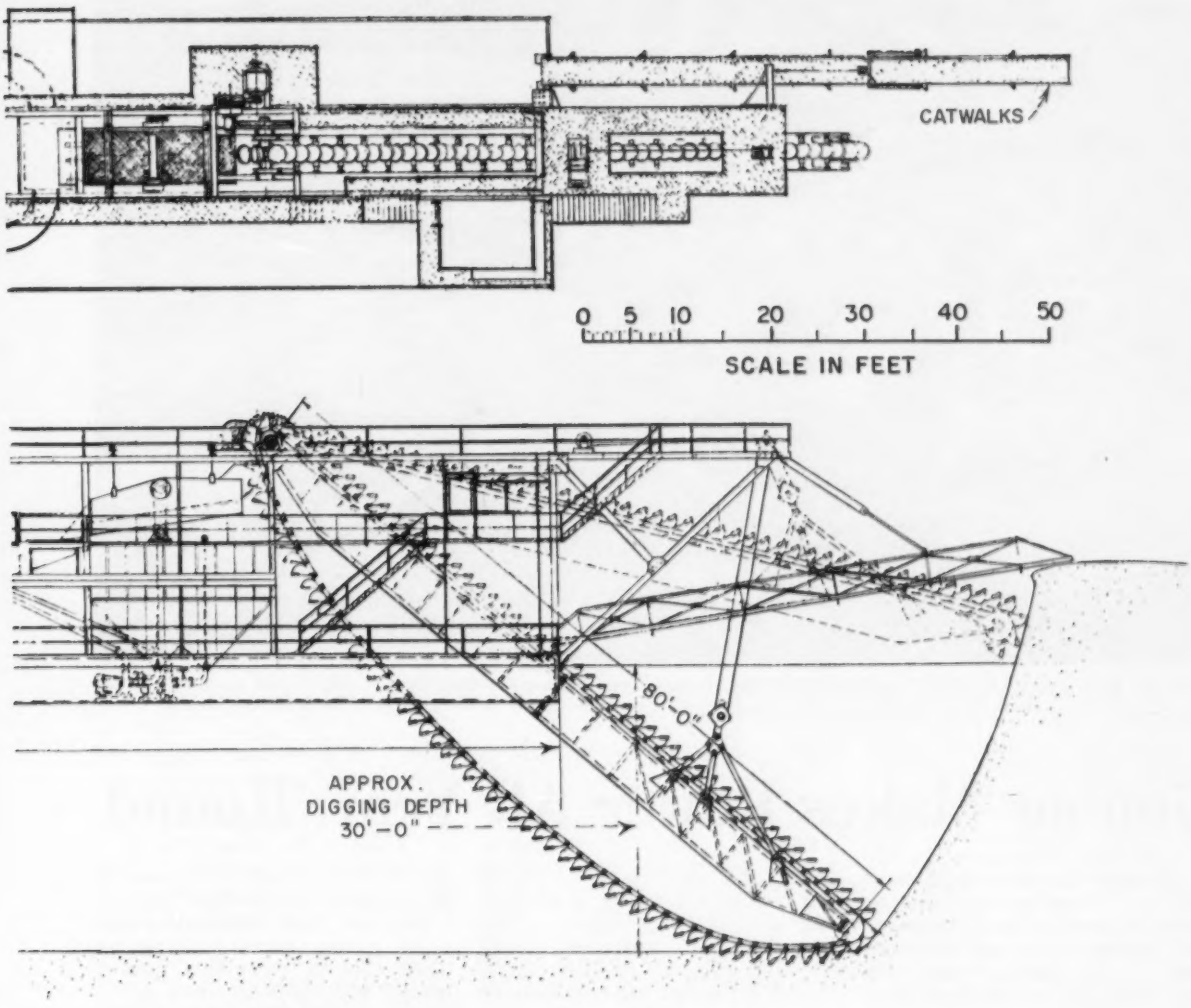
Major Welding Manufacturer Recovers

POSTWAR SCARCITY OF DOMESTIC RUTILE sources for welding rod coating led Hobart Bros., large welding machinery manufacturers of Troy, Ohio, to seek and develop its own deposits of rutile in the U.S. The search resulted in acquisition of extensive reserves near Vero Beach on the east coast of Florida. Mining started with a floating dredge in 1952, but this model proved to be unsatisfactory.

So the company marshalled its engineering and construction staff, under direction of company president, E. A. Hobart, as chief engineer and designer, and produced the floating dredge illustrated above. The all-welded dredge was built in the company's plant at Troy. Construction included all electrical equipment in the unit. After a test run on a gravel deposit in Troy, the dredge was disassembled and shipped to Florida on 20 freight cars.

As shown in the above illustration, the link-bucket dredging head can go as low as 40 ft below the bank, or 30 ft below the water level. Buckets hold about 2 cu ft of sand. Value of rutile in each bucket is about 2c. Buckets come up at the rate of about one each second and feed the gravity concentrating plant in the stern of the dredge.

Bucket discharge goes over a vibrating screen which scalps off debris. The slurry containing sands and heavy minerals is then pumped through distributors which feed the pulp to a complex series of sluices. Schematic flowsheet at left traces the distribution of feed containing 2,000 gal of water and 400 tons of sand containing 2% heavy minerals. This is upgraded to 4% through a 384-sluice unit. The partially concentrated sand is then upgraded further by a series of four additional sluicing units in sequence, yielding a final product which contains 64% heavy minerals. The plan, end view and side view of the dredge show the relative positions of the distributing boxes, sluicing units, and pumps. Tails discarded from each



containing only 2% heavy minerals to a concentrate containing 64% heavy minerals including rutile, ilmenite and zircon.

Rutile in Florida

sluice gather in a central discard launder.

Sand concentrates containing 64% heavy minerals are then sent to the company's dry mill near the Florida deposit. Here the product is fed over tables to remove remaining silica sand and yield a concentrate containing three marketable minerals—rutile, ilmenite and zircon. These are separated electrostatically and magnetically into three products.

In describing the Florida operations, E. A. Hobart points out that the U. S. Government has been much interested in encouraging domestic production of rutile. He comments that "the last report from the U. S. Bureau of Mines gives 107,000 tons obtained from the beach sands of Australia and only 12,000 tons from our own Florida beach sands. Of this 12,000 tons at the present time, National Lead and ourselves are probably the main producers of rutile, although DuPont at Trail Ridge is the biggest producer of ilmenite in Florida."

With the new dredging operation, Hobart Bros. is now able to fill its own requirements for rutile for welding rod coating and supply additional amounts to competitors in the electrode field as well.

Before the company designed and built its present dredge, it experimented with a conventional sand dredge equipped with a rotary cutting head feeding a high-pressure pump which forced the mineral slurry through a long pipeline to a primary separator or wet stage. This upgraded mineral content to about 40%. Product went to a series of tables where it was upgraded to 85 to 90%, then dried and separated electrostatically. By comparison, Hobart reports that the new unit has much greater capacity, dredges to a greater depth, and eliminates most of the costly repairs of the rotary cutting head. The new unit requires only an occasional hard-surfacing of the bucket edges. Discard of sand from the feed is faster in the new dredge.

ONE OF CANADA'S MAJOR URANIUM MINES, Gunnar takes ore from its open pit operation and mills it at the site. Mine will eventually go underground as it follows the orebody. Power is being supplied by Nordberg diesels.

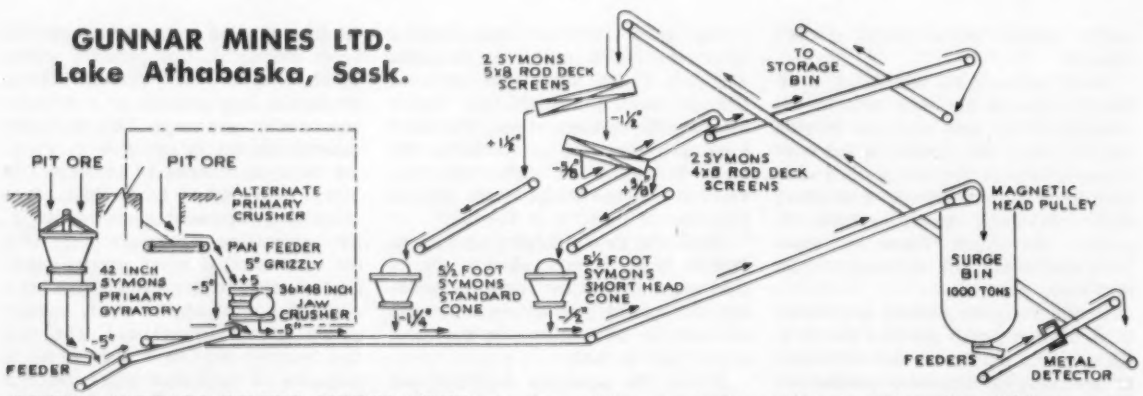
Gunnar Makes Power All Year 'Round

To PRODUCE URANIUM concentrate from its 1,250-tpd treatment plant on the north shore of Lake Athabasca, Sask., Gunnar Mines Ltd. had to do more than just open a property and start mining. Power for mine, plant and an 800-person community had to be provided from scratch.

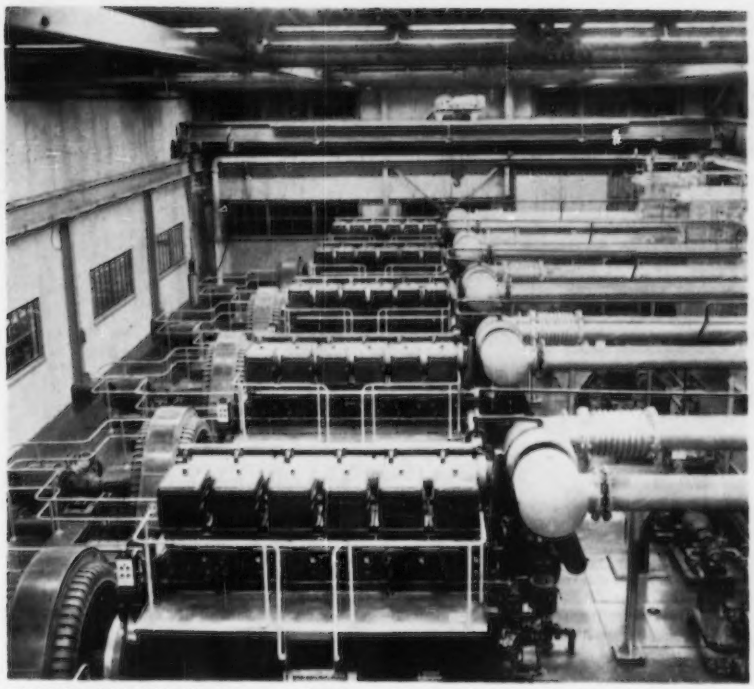
Construction of mine, mill and townsite in an area which does not lend itself to hydroelectric generation led Gunnar to choose a diesel-electric power plant. Five Nordberg four-cycle diesel engines were placed in service and a sixth was installed in July of this year. At initial stage, in the summer of 1954, four engines arrived with other heavy equipment, cement and other structural materials. Earth-moving equipment had been flown in from March to May.

Engines have six cylinders of 13-in. bore and 16½-in. stroke and each is rated 1200hp at 450 rpm. They are directly connected to English Electric 2300v, 60 cycle generators, rated 845kw. During a recent one-year period, the power plant generated 18,845,850 kwh and consumption of fuel averaged 16.84 kwh per Imp. gal.

Extremely cold temperatures naturally present special problems for Keith Crotean, mechanical superintendent and Oli Kristjanson, power house superintendent. The year's supply of diesel fuel, 1.6-million Imperial gallons, is brought in by barge each summer. The tank farm is located near the docks and is 800 ft from the powerhouse. Imperial Esso fuel oil No. 46, which is classified as a Bunker "C" or No. 5 oil, is burned. Since it



DESPITE AVERAGE WINTER TEMPERATURE of minus 10 deg, Gunnar's plant runs year 'round. Heated Euclids deliver ore to the crushers in cold weather. All heavy equipment for the project had to be brought in by barge.



PLANT CAPACITY goes to 5070kw with installation of the sixth Nordberg diesel in the mine's power plant. Auxiliary manufacturers aided in design.

has an API gravity of 10.1 and a pour point of zero degrees F, each storage tank contains a heating coil with 42 sq ft of heating surface.

System is sufficient to maintain a flow of approximately 7 gpm through a 3-in. Viking gear type pump, even in the coldest weather (minus 55 deg F).

Because of the solid rock in the area, the oil lines and all other service pipes are not buried. Instead, they are encased in wooden, heated pipe boxes that are supported above the ground. The pipes are wrapped with a tough moisture resistant paper and intervening spaces in the box are packed with wood shavings. This affords good protection and seldom are any pipes frozen.

At the power plant, the temperature of the oil is raised to 180 deg F in two Rosenblatt plate type heat exchangers. It is then cleaned in either of two Sharples Nozljector Recycle centrifuges and stored in five, 1,000 gpd tanks. These are lagged with 1½-in. of magnesia block insulation and the oil retains a high percentage of its heat prior to use.

Cooling water is drawn directly from Lake Athabaska to a 1,000-gal storage tank in the powerhouse. A conventional, indirect type cooling system, with a Ross heat exchanger, is employed. A Zeolite water softener is used to supply make-up water for the engine jackets.

Barrels of lubricating oil are brought in each summer by barge and are stored in the warehouse yard, from which distribution is made as required. Nearly 10,000 gal were consumed during 1956.

Exhaust gas from the Nordberg diesel engines is utilized in two ways. It is initially passed through Foster-Wheeler waste heat boilers and produces 3000 lb of 50 psig saturated steam per hour per engine at full load. The gas then passes up the exhaust pipe which is surrounded by the scavenging air intake pipe. In this way a reasonably constant air intake temperature is maintained.

The steam which is produced is used in heating the many plant and camp buildings. All buildings are of modern construction and are supplied with chlorinated water, electricity and steam heat. A considerable quantity of steam is also produced in the acid plant, which produces 100 tons of 100% sulphuric acid each 24 hours.

The Gunnar mill, including the crushing section and the laboratories, is enclosed in a 550-ft long structural steel building. Powerhouse is connected to this building by an underground tunnel and the acid plant is a separate unit. A plant service building houses the offices, departmental workshops, warehouse and garage. The mine dry house will accommodate 400 men and provides facilities for both open pit and underground miners.

The extreme cold temperatures have presented many problems in the year round operation of the open pit mine and the mill. However, these have been overcome by modifying standard equipment and the incorporation of improved accessories on new items of equipment by cooperative manufacturers.

Orebody at Gunnar resembles a massive pipe which plunges from the surface at a 45 deg angle for a known length of 1400 ft. Its diameter near the surface is about 450 ft and this upper portion will be mined by open pit. The lower portion of the pipe lies beneath Lake Athabaska and is protected from the lake by a 400-ft-thick sill. This ore will be removed by underground mining methods.

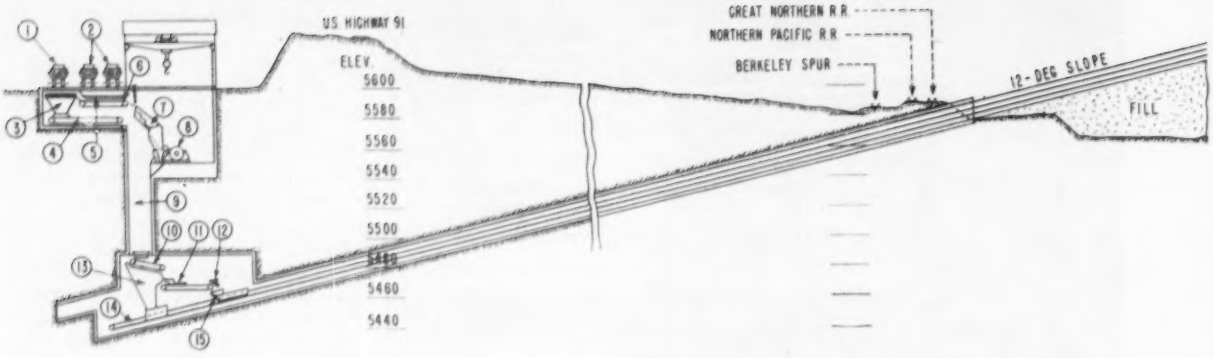
Development of the open pit involved the removal of 353,000 cu yd of overburden and 900,000 tons of waste rock capping. It consisted of 2 to 3 ft of muskeg, 20-60 ft of frozen glacial silt and huge tongues of crystal clear ice scattered throughout the overburden.

Current tonnage from the open pit is about 35,000 tons of waste and

(*Continued on p 134*)

Auxiliary Equipment Improved Performance At Gunnar's Saskatchewan Site

Generators	English Electric Co. of Canada
Governors	Woodward Governor Co.
Turbochargers	DeLaval Steam Turbine Co.
Fuel transfer pumps	Haight Pump Co.
Fuel filters	Winslow Engineering Co.
Fuel oil heaters	Kewanee-Ross Corp.
Fuel injection pumps	Scintilla Div.—Bendix Aviation
Lube purifiers	Winslow Engineering Co.
Lube oil pumps	Geo. D. Roper Corp.
Lube coolers	Kewanee-Ross
Jacket water pumps	Weinman Pump Mfg. Co.
Intake air filters	American Air Filter Co., Inc.
Air compressors	Quincy Compressor Co.
Air intercoolers	Young Radiator Co.
Exciter	English Electric
Switchboard	English Electric
Pyrometer	Illinois Testing Labs., Inc.
Alarm system	Viking Instruments, Inc.
Switchgear	English Electric Co.



LEGEND

1. 35-ton truck discharges material from sections of pit containing old underground timbered workings onto Wobbler unit.
2. Two 35-ton trucks with regular pit ore empty load at same time into hopper.
3. Universal Engineering Corp., 13-bar Wobbler.
4. Link-Belt conveyor, 60 in. by 45 ft 2 in., troughed, carries dribble from Wobbler to storage bin.
5. Hopper.
6. Manganese-steel pan feeder, 60 in. by 30 ft.
7. 6x14-ft vibrating screen with 8-in. openings.
8. Birdsboro-Buchanan 60x84-in. Blake type jaw crusher.
9. 12-ft dia concrete and rail lined storage bin. Capacity: 380 tons.
10. Manganese-steel pan feeder, 60 in. by 24 ft.
11. L-B 72-in. by 30-ft flat picking belt with electronic metal detector and operating at 125 fpm.

Berkeley Pit Crushing-Conveying Plant

JOHN B. HUTTL

IN DESIGNING the new primary crushing plant and ore transportation and loading system, with a large stockpile area ahead of loading bins, now nearing completion at the Berkeley pit in Butte, Mont., Anaconda engineers had to consider the following requirements: (1) A crushing plant site that would assure shortest haulage from benches during life of the pit and within easy reach of any conveyor of rock-over skip system that might be required at some future date, and (2) an ore transportation layout that would negotiate U. S. Highway 91 skirting the southern rim of the pit and three rail lines (Berkeley pit spur, Northern Pacific R. R., and Great Northern R. R.) with safety and minimum interference during construction and thereafter.

How the problem was solved is shown in the accompanying illustrations. The complete installation consists of a crushing plant partly underground at the southern rim of the pit, with truck dumping facilities on the surface; concrete-lined bin underground to store crushed product from crusher; long belt conveyor operating in part in a 610-ft concrete-lined incline leading to the stockpile area about halfway between the crusher building and loading bins; and feeder and belt conveyor systems connecting the stockpile area with a battery of circular steel loading bins capable of storing 5,000 tons of crushed ore. The complete plant layout can handle a maximum of 1800 tph. All belts are interlocked, have an accelerating period of 45 sec average. The larger units are equipped with zero speed limit and alignment limit switches. Protection against tramp iron is provided by electronic metal detector and magnet on picking belt discharging to the incline belt conveyor leading to the stockpile area. Operators are warned of equipment failures by horn, light signals and by telephone.

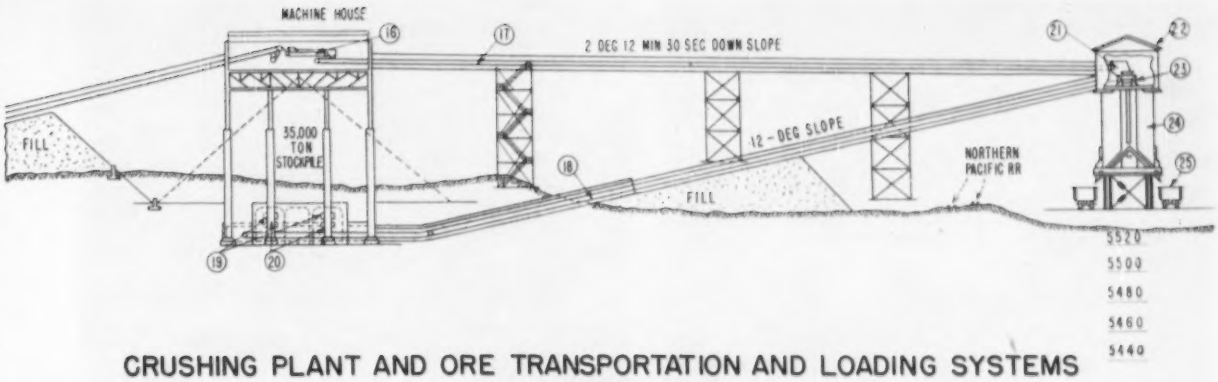
Crushing Plant

Design of the truck dumping area adjacent to the crusher building permits simultaneous dumping of three trucks. Two trucks loaded with clean pit ore can dump into a steel hopper with a 60-in. by 30-ft Armco pan feeder at the bottom, while one truck with material from pit sections in which old underground timbered workings are present empties its load onto a 13-bar Wobbler unit 5 ft wide. Oversize from the Wobbler goes to the pan feeder handling hopper material which, in turn, discharges to a 6x14-ft vibrating screen with 8-in. openings ahead of the crusher. The undersize, or dribble, is transported by a 60-in. by 45-ft 2-in. belt conveyor to a 380-ton, 16-ft dia, concrete-lined storage bin equipped with a 60-in. by 24-ft Armco pan feeder. The bin also receives undersize from the vibrating screen and 8-in. crusher product by gravity.

The crusher is a 60x84-in. Blake type. It is housed in a steel and concrete building containing a 50-ton overhead crane and a 5-ton auxiliary crane to facilitate repairs. The dust collecting installation serving the crushing plant consists of Joy Micro-dyne dust collectors. The crusher is fully protected against overload and tramp iron by both electrical and oil pressure controls.

Crushed ore withdrawn at the bottom of the storage bin is fed by pan feeder onto a 72-in. by 30-ft flat picking belt discharging over manganese grizzly bars to the incline or No. 1 belt conveyor which leads to the stockpile area. This unit is 48 in. wide, troughed, 1,037 ft long between pulley centers, and operates at a speed of 400 fpm. It is powered by two 300hp motors. More than half of its length operates in the 12-deg concrete-lined incline under U. S. Highway 91 and rail lines mentioned previously.

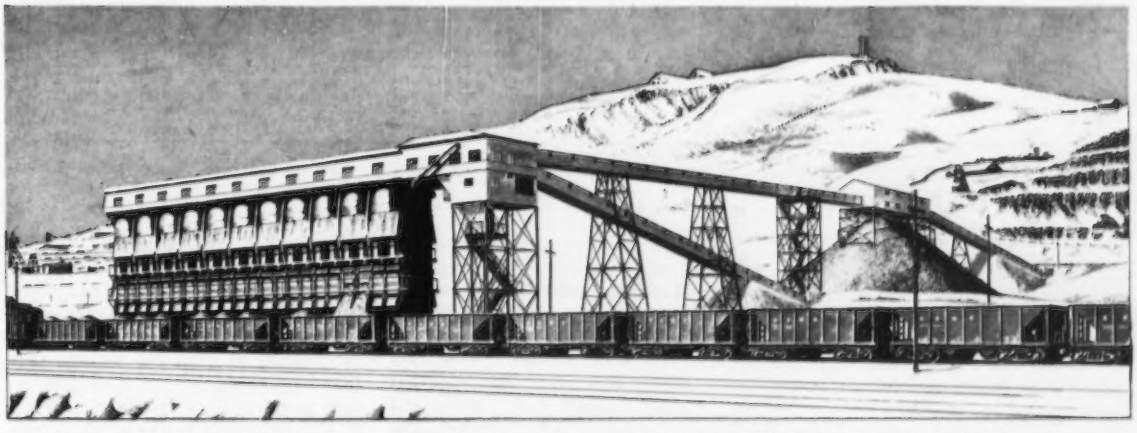
The incline opening was driven by conventional methods with a cross-section (semi-circular roof) roughly measuring 10 ft 9 in. high and 15 ft wide. Measurements inside the concrete lining, respectively, are 9 ft 9 in. and 13 ft. See illustration showing



CRUSHING PLANT AND ORE TRANSPORTATION AND LOADING SYSTEMS AT BERKELEY PIT

12. Dings magnet.
13. Dribble chute.
14. L-B 48-in. by 1037-belt conveyor (No. 1). Tandem drive. Two 300hp motors. Belt speed, 400 fpm.
15. Manganese steel grizzly bars.
16. L-B 60-in. by 20-ft shuttle conveyor. Belt speed, 250 fpm.
17. L-B 48-in. by 503 ft 8½-in. belt conveyor (No. 2). Powered by 30hp motor. Belt speed, 400 fpm.
18. L-B 48 in. by 557-ft belt conveyor (No 3). 300hp motor, belt speed, 400 fpm.
19. Four 60-in. by 24-ft manganese steel feeders.
20. Four 60-in. by 26-ft dribble belt with manganese steel grizzly bars.
21. Transfer chute with manganese grizzly bars in transfer tower.
22. Transfer tower ahead of loading bins.
23. L-B 60-in. by 195-ft belt conveyor (No 4) with special heavy-duty, self-propelled tripper. Belt speed, 500 fpm.
24. Two rows of circular, V-bottom steel bins. Each bin has two air-operated loading gates to permit two-side loading.
25. 70-ton steel gondola cars.

Designed to Handle 1800 Tons per Hour

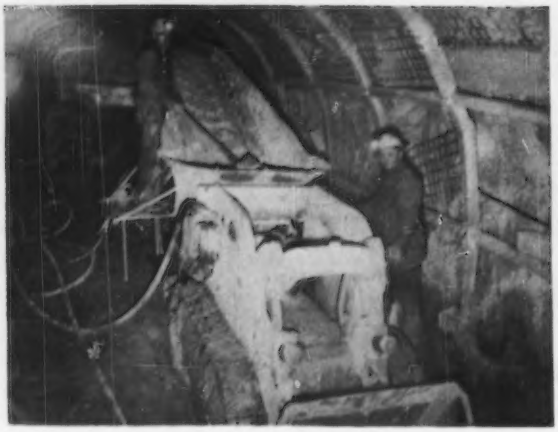


STOCKPILE holds 35,000 tons; bins hold 5,000 tons. Drawn by Bill O'Neill of Anaconda's geological department.

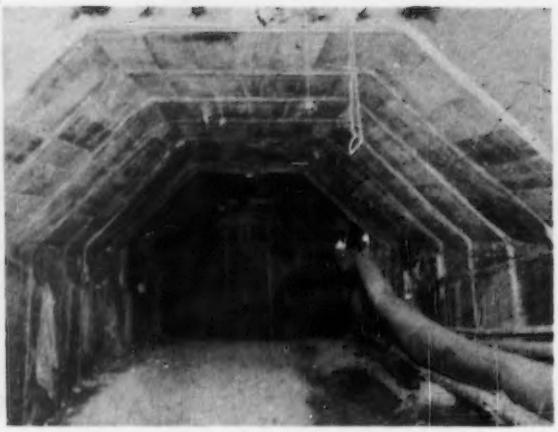
details of design of cross-section, steel set installed prior to placing concrete lining, and the concrete lining. Rounds were drilled with air-leg drills. Material broken in the face was loaded mechanically into a 6-yd Koehring Dumptor in a unique manner. The loader available was an Eimco 630 unit, but dumping height of the bucket, however, was too low for loading the Dumptor direct. The difficulty was overcome by using a short conveyor assembly on wheels (conveyor section of an Eimco conveyor loader) between the loader and Dumptor. To provide better traction for the loader operating on a 12-deg slope, worn drill bits were welded to the pads of the loader tracks. Material hauled to the surface by the Dumptor (equipped with exhaust conditioners) was used to build up the stretch of ramp a short distance from the incline portal to support the conveyor gallery terminating at the head of the stockpile area.

Another novel operation, carried on in the incline during construction and where ground conditions were favorable, involved transfer of mixed concrete from the surface direct to the sectionalized forms underground. This was done by drilling 4¾-in. holes from the surface with a Joy 225 truck-mounted, diesel-powered rotary drill using Tricone type bits to the center of the roof of the form set up in the incline. Holes were lined with 4-in. pipe to transport the concrete pour. See illustration. Vents at the ends of the 20-ft form permitted air to escape while level of concrete was rising in form during pour. A conventional Pumpcrete machine was used for concreting sections of incline in adverse ground. Ventilation in the incline was furnished by blower fans installed at the portal attached to 24-in. Ventube ducts.

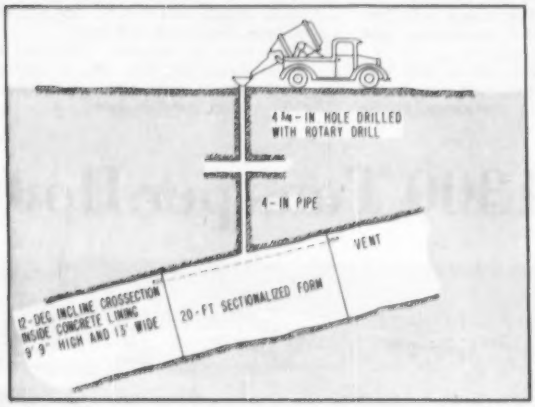
The concreted room, extending from the foot of the incline to a short



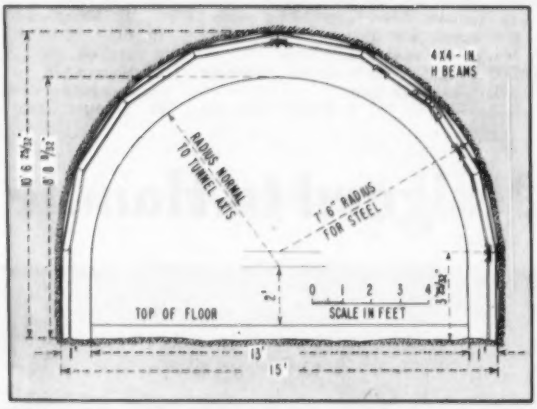
MUCK FROM CONVEYOR TUNNEL is loaded into 6-yd Koehring Dumptor with Eimco tractor-mounted 630 loader.



STEEL REINFORCED room at foot of conveyor tunnel will house pan feeder serving 380-ton storage bin.


4¾-IN HOLE DRILLED WITH ROTARY DRILL
4-IN PIPE
VENT
12-DEG INCLINE CROSSECTION INSIDE CONCRETE LINING 9' 9" HIGH AND 13' WIDE
20-FT SECTIONALIZED FORM

BATCH TRUCK drops concrete for lining of incline through 4¾-in. hole drilled with rotary drill.



CROSS-SECTION of main 12-deg belt incline shows position of 4x4-in. H beams reinforcing tunnel.

distance beyond the center line of the storage bin and containing the pan feeder serving the storage bin and picking belt, was established by top slicing stoping method. First, an incline was driven to back of room, excavating and catching back by means of special sets (steel). Then a middle cut was made, followed by mining bottom cut to give room full height. The storage bin was excavated by driving a pilot raise to crusher room and then slashing opening to desired size.

Stockpile Holds 35,000 Tons

Capacity of the concrete floor of the stockpile area is about 35,000 tons. Galleries of the different belt conveyor units commencing and terminating there, and housing covering transfer points and shuttle conveyor, are supported by a rectangular steel column structure. Below the floor mentioned is a concreted tunnel area containing four 60-in. by 24-ft Armco pan feeders for transferring stored ore over manganese-steel grizzly bars to No. 3 belt conveyor (12-deg incline) discharging to a transfer chute at the head of the loading plant. Underneath each feeder is a 60-in. by 26-ft flat belt to catch dribble from feeder and direct it to No. 3 belt conveyor. The stockpile area can be bypassed whenever this is desired. This is done by directing feed from No. 1 conveyor to a 60-in. by 20-ft troughed shuttle conveyor operating at a speed of 250 fpm and discharging to No. 2 belt conveyor leading to the transfer chute at the loading plant. No. 2 belt conveyor on a down slope of 2 deg 12 min 30 sec is 48 in. wide, 503 ft 8½ in. long between pulley centers, and operates at 400 fpm. Power is supplied by a 30hp motor. The No. 3 incline conveyor driven by a 300hp motor is 48 in. wide, 557 ft between pulley centers, and speed is 400 fpm.

The loading plant consists of two rows of 11 circular, V-bottom steel bins resting on a steel column base. Storage capacity is 5,000 tons. The bins are about 16 ft high, and width between each twin-bin section is 26 ft. Two air-operated loading gates at the bottom of each bin permits two-side loading of 70-ton steel gondola cars preparatory to haulage in trains to the reduction works at Anaconda some 26 miles distant.

60-In. Belt Feeds Bins

The belt conveyor system installed on top of the bins consists of a 60-in. by 195-ft belt unit with a special heavy-duty, self-propelled tripper taking its load from the transfer chute equipped with manganese-steel grizzly bars at the head of the bin structure. The unit operates at a speed of 500 fpm and is powered by a 125hp motor. The housing unit on top of the bin is a steel-frame structure covered with corrugated iron sheets. Adequate lighting and heating facilities during the severe winter months are available in the building.

MANEUVERABILITY of the two rubber-tired vehicles, one for handling waste and one for mucking and dumping ore, has improved output per man-day radically. Autovagone (above) places fill in a mined out stope at the Sardinian property.

How Montevecchio Cut Haulage Costs

A LONG LINE OF IMPROVEMENTS, topped by increased output per man-day, has been chalked up by Montevecchio Co., the group which operates the lead-zinc mines of Sardinia. Prime instruments in the program which saw output increased from 45½ cu yd of ore to 84½ were the "Autovagone Montevecchio" and "L'autopala Montevecchio," two machines developed by Atlas Copco of Italy at the request and to the specifications of the mining company.

The autovagone, or "motor-wagon" is a rubber-tired hauler which is designed to dump ore down an ore pass or place fill underground. L'autopala consists of the same rubber-tired frame and automatic rear-dump body, but has a loading bucket attached to the front.

Most Montevecchio mines use the cut-and-fill method of mining since subsidence is a problem. A large sink-float plant at the mine site provides a properly sized waste which is delivered to the stopes by chutes. The autovagone is used here for transporting waste to the stope from overhead bins, as well as for ore transport.

Fill is also available from the individual working areas which are mined by sub-level caving and which do not require replacement of waste.

Prior to introduction of the new machines, Montevecchio loaded waste and ore by hand and by conventional rail-mounted overhead power shovel, which fed 16 cu ft mine cars. Cars were then pushed and hand-dumped into the ore passes. With introduction of the rail-mounted shovel, output per man went from a range of 6½ to 9 cu yd to a 19½-45½ cu yd range.

Since the shovel was tied to the laid track, only a percentage of the mined ore could be handled mechanically. Depending on working conditions, this percentage varied between 30% and 85%. Even under the most favorable conditions, a remaining 15%, representing cleaning up of the

L'Autopala Is Designed to Operate in a Small Space

	T4G	T2G
Length, bucket and body down	14 ft, 2 in.	10 ft, 8 in.
Height, bucket up	8 ft, 6½ in.	6 ft, 9 in.
Height, bucket down	5 ft, 7 in.	4 ft, 6 in.
Width, including step plate	5 ft, 7½ in.	4 ft, 4 in.
Wheelbase	5 ft	2 ft, 11 in.
Bucket capacity	8¼ cu ft	3½ cu ft
Body capacity	58 cu ft	25 cu ft
Traveling speed (fps)	3.2	4.1
Net weight (lb)	6,600	4,400

floor, had to be man-handled. For discharging the fill, always done by hand, a simple end-tipping tub was used and yield, for a tramming distance of about 82 ft, was about 26 cu yd per day.

First attempt at using self-propelled vehicles to transport fill was made in 1951 with adoption of a self-contained truck of 2 cu yd capacity driven by a compressed air motor. Truck ran on the rails originally laid for the power shovel when the stope was mined. Dumping of the 2 cu yd hopper was automatic. To increase efficiency of the "ercolino," a second 2-yd truck with automatic side dump was coupled to the first. Despite menace of the rails to the long trailing compressed air hose, the two-truck unit set output of 78 cu yd per day of placed fill, with the unit ranging over a run of 328 ft.

In 1953, l'autovagone was born. Mounted on tires, it combined the advantage of rapid hauling that was the strong point of the ercolino, with the elimination of rails and prescribed movement.

Operating from fill raises from 82 to 164 ft apart, the autovagone discharged 195 to 260 cu yd per day with one operator. Danger to the dragging air hose was also eliminated. Placement of fill, Montevecchio designers note, was also improved and dust kept to a minimum. With such notable success, the designers immediately made arrangements for manufacture of more machines and for construction of a smaller machine for specific use in confined and difficult working places.

At the present time, two models of l'autovagone are at work in the mines, the original 2-cu yd model and the new 1-yd machine, which works in narrow drifts and stopes and performs final cleanup.

Enter L'Autopala

With the record of efficiency and adaptability set by the wheel mounted autovagone, Montevecchio's men promptly went after a combination loader-hauler which would completely eliminate the need for track-laying underground and improve coverage of the mucking area. In 1954, after long preliminary investigation, the first power-driven loader-hauler arrived at the mine.

The loader-hauler is a multiple use machine. It loads ore from the muck pile, transports it to the ore pass and dumps. Operation is continuous and more efficient than previous method.

The larger of the two Atlas Copco models, the T4G, now in operation at Montevecchio, has an actual capacity of 2.14 cu yd and is filled, when operating, at an air pressure of 85 psi with a seven-load-per-minute average.

Model T4G's bucket cleans the floor as it loads and is powerful enough to penetrate well into the muck pile for each load. With discharge over a haulage distance of about 72 ft, and barring time for breaking oversized fragments, output of the machine averages 54½ cu yd per hour. Traveling speed of the machine is 3¼ fps. Distance of haul and size of the muck are, of course, very important to performance statistics of the machine.

Just as the autovagone, owing to its long operating range, allows for an increase in the distance between the fill raise and the disposal point, the autopala too, being self-contained and having a wide range, permits the siting of ore passes up to 328 ft. As number of passes can be reduced, so can over-all mining costs.

Atlas Copco's model T2G, also going into use at Montevecchio, is a smaller version of the prototype, with a 1-cu yd hopper. It performs best where the floor is irregular.

Choosing the Right Diamond for the Drilling Job

YOUR DRILL PROGRAM, and its success, depends upon a number of factors, including, as *E&MJ* pointed out in the June 1957 issue, choice of diamond size and type in core bits.

We are indebted to Patrick Adamson, of Wheel Trueing Tool Co., for a revised table of diamond core recommendations, compiled by Joy Manufacturing Co.

The article which contained the earlier table discussed the various kinds and sources of diamonds, with particular attention paid to the structure and shape. Setting of the stone in the matrix has great bearing on the life and efficiency of the bit, and, as Mr. Adamson points out, diamonds properly oriented and set can drill any rock formation.

The new table, which follows, is an up-dated version of the one which appears on p 91 of the *E&MJ* article.

Density of ground	Geological formation	Diamond size range (per carat)	Matrix*
Very soft	a. Massive unbroken (chalk)	8 to 16	Standard
	b. Broken (fine clay)	8 to 16	Standard
Soft	a. Silt shale	8 to 16	Standard
	b. Weathered shale	8 to 16	Standard
Medium Hard	a. Sandstone	16 to 30	Standard or "L" hard
	b. Fractured sandstone, etc.	8 to 16	Standard or "L" hard
Hard	a. Hard limestone or dolomite	30 to 60	Standard or "L" hard
	b. Cherty broken limestone	16 to 30	"H" hard
Very hard**	a. Hard igneous rock	60 to 110	Standard
	b. Fractured igneous rock	30 to 60	Hard

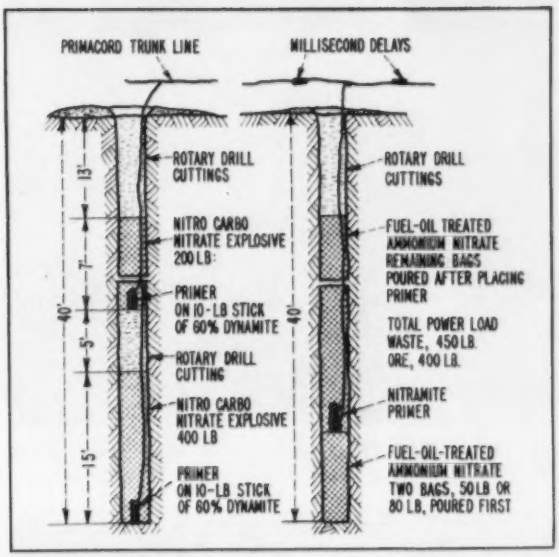
Notes:

* Rockwell "C" Scale of Hardness (approximate)

Matrix	Rockwell	Application
Standard	5 to 20	For all general drilling
"L" hard	20 to 32	More abrasive resistant
"H" hard	32 to 60	Fractured or broken rock

** For hematites, jaspers and/or taconites, use 60 to 110 per carat in uniform solid rock ($10.50 quality); but use lesser quality or impregnated type in fractured or broken ground.

Select the quality of diamonds to be used on a "per-foot cost basis," determined by comparing results.


PRIMACORD TRUNK LINE
MILLISECOND DELAYS
ROTARY DRILL CUTTINGS
NITRO CARBO NITRATE EXPLOSIVE 200 LB
PRIMER ON 10-LB STICK OF 60% DYNAMITE
ROTARY DRILL CUTTING
NITRO CARBO NITRATE EXPLOSIVE 400 LB
PRIMER ON 10-LB STICK OF 60% DYNAMITE
13'
7'
40'
5'
15'
ROTARY DRILL CUTTINGS
FUEL-OIL TREATED AMMONIUM NITRATE REMAINING BAGS POURED AFTER PLACING PRIMER
TOTAL POWER LOAD WASTE, 450 LB. ORE, 400 LB.
NITRAMITE PRIMER
FUEL-OIL-TREATED AMMONIUM NITRATE TWO BAGS, 50 LB OR 80 LB, POURED FIRST
40'

BEFORE AND AFTER of blasting practice at Butte compares method used by contractor (left) and ammonium nitrate system.

END PRODUCT of Anaconda Co.'s careful "assembly line" technique is a safe, low-cost blast with good fragmentation.

At Berkeley Pit, Blasting Is an Art

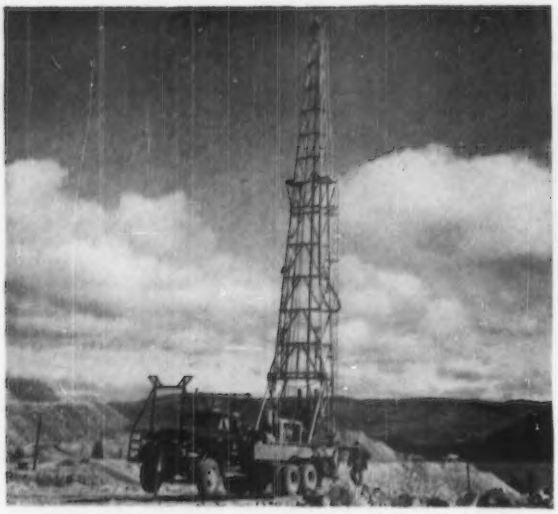
RECENT ADOPTION of ammonium nitrate of fertilizer grade for blasting ore and waste benches in the Berkeley pit of Anaconda Co. in Butte, Mont., has brought about a material reduction in over all mining costs, and has improved safety and efficiency. Here, as at Weed Heights, Nev., company engineers proved again that ammonium nitrate, when mixed with the right amount of fuel oil and when properly applied and handled, becomes a most versatile and effective explosive.

It is well known that ammonium nitrate in its conventional fertilizer-grade form is not an explosive material. However, it has been used as an ingredient in explosives for many years and, lately, in combination with carbon black, sulphur, sawdust or other such combustibles as a slow-speed, low-cost explosive detonating at a rate of about 2000 meters per second. Mixing fuel oil from 5 to 6% by weight (at Berkeley pit about 8.5% is used because there is some loss of fuel oil in bag itself) with ammonium nitrate results in the high-value explosive used in many open pits today. Its rate of detonation ranges from 4000 to more than 6000 meters per second. Since the ammonium nitrate alone is not cap-sensitive, it is safer to handle, store and transport than most other explosives.

Experience at the Berkeley pit shows that prill size and uniformity and thorough coating of prills with fuel oil are prime requisites to effective blasting. The ammonium nitrate used is granular and contains a minimum of fines. It is received at the pit in 50- and 80-lb paper bags, with the smaller bags to become standard in the near future. This because of convenience of handling. Addition of fuel oil takes place while the bags are grouped around the hole to be loaded. Amount used per 50-lb bag is ½ gal and about 1 gal for the 80-lb bag. The prills are effectively coated while the fuel oil slowly percolates to the bottom of the bag; no mixing is required. Use of a mixture made up of two-thirds diesel oil and one-third discarded motor oil from the truck maintenance shops has been discontinued. It was found after tests that the heavy sludges contained in the discarded motor oil reduced percolation in the bag.

SUPERINTENDENT George W. Parker is in charge of the Berkeley Pit.

Detonation of row of loaded holes is done with Primacord and 5 lb Nitramite primers. This provides maximum safety around the blasting site and, because the Nitramite primer is less sensitive than most other primers, the holes themselves are safer. As to first cost, the nitro carbo nitrate previously used costs about $225 per ton (11.25c per lb up to Nov. 1, 1956) in contrast to $78.25 per ton for the fertilizer-grade ammonium nitrate. In addition, only one primer is used in current blasting practice. Two were used with nitro carbo nitrate blasting employed by a contractor during development of the pit. With a daily powder consumption of nearly 20,000 lb, the savings effected are obvious. Before continuing the description of loading and blasting technique currently employed at the Berkeley



1 **TRUCK-MOUNTED** Joy 225 diesel-powered rotary drill with 6¼-in. Tricone bits puts down 32-ft blastholes in waste.

2 **TRACK-MOUNTED** Bucyrus-Erie 40-R electric-driven rotary is drilling 40-ft blastholes along 33-ft benches.

3 **POWDER CREW** unloads bags from truck and places required number around 9-in. blasthole in first step.

4 **POWDER MAN,** one of the well-trained crew of five, slashes tops of the bags as drill goes to next position.

pit, a few details on pit layout, character of ore and waste mined, bench heights, blasthole drilling and drill patterns may be of interest.

The Berkeley pit is at the eastern end of the Butte Hill. Actual ore production started in October 1955, and since then and until May 1, 1957 some 3.4-million tons of ore assaying slightly less than 1% copper have been shipped to the reduction works at Anaconda. The pit is oval in shape and laid out for spiral entry. When fully developed, it will measure 4600x2600 ft at the top, with the deepest point at which mining will be carried on about 490 ft below elevation of U.S. Highway 91, skirting the southern rim of the pit. Slopes on the pit ultimately will be 45 deg. The scheduled daily ore production of 17,500 tons was reached early in September 1957. Current waste-ore ratio is about 3.21:1. Total ore reserves now total more than 100-million tons.

The ore zone averaging 250 ft in thickness is covered by 200 ft of overburden consisting of heavily iron-stained granite. It is an altered granite in which the chief ore mineral occurs as secondary chalcocite. Copper minerals are found in the ore zone in numerous small veinlets, as well as disseminated through the altered granite. The pit is also traversed by two dikes of quartz porphyry. Waste material is medium hard and the ore fairly soft.

Save for four benches established at the start of pit development, most benches are now carried at a height of 33 ft. The lower benches are kept active in sections of the pit where some horses of waste extend into the ore zone, making possible separation of ore and waste with minimum dilution and consequent better control of selective mining.

Two types of rotary drills are used on the benches for drilling required 6¼-in. and 9-in. blastholes, namely, three B-E 40-R electric-powered units with 9-in. Tricone-type bits and a truck-mounted, diesel-powered Joy

5 **SECOND MAN** pours diesel oil into ammonium nitrate bag. Prills must be uniformly oil-coated for good results.

6 **TWO BAGS** containing about one-half gallon of oil are dumped into the bottom of the hole. Primer is handy.

7 **PRIMER,** 5½ lb Nitramite, is tied with Primacord in the next "assembly line" step. All safety rules are kept.

8 **CAREFUL PLACING** of the primer follows. Extra fuel oil is used to allow for some absorption by paper sacks.

225 drill using 6¼-in. Tricone-type bits. All bits are either of C-P or Hughes make. The smaller drill, because of its mobility, is used principally in pit sections remote from power cable contacts and at sites where special holes are needed quickly. Blastholes on the ore benches are drilled 5 ft below grade, or to a total depth of 38 ft, and those on waste benches 7 to 8 ft below grade, or to 40 to 41 ft. Spacing between hole centers is 21 ft and distance from toe 24 ft. Resulting drill cuttings are used for stemming.

This method was practiced by a contractor before Anaconda Co. took over pit operations. The 9-in. and 6¼-in. blastholes were drilled to the same depths mentioned in the foregoing paragraph, but spacing between hole centers ranged from 15 to 21 ft and the distance from the toe 21 ft. The drilled rows of holes were loaded with nitro carbo nitrate explosive and primers, consisting of 10-lb sticks of 60% dynamite, and fired electrically. Near the end of the contract, electric millisecond delays were used and the number of primers used per hole was cut back to one. The 9-in. holes carried a powder load of about 600 lb. Figure on p. 107 shows how powder load was distributed and where primers were placed.

The explosive used is conventional fertilizer-grade ammonium nitrate treated with diesel oil, as mentioned previously. Primer used in both 9- and 6¼-in. blastholes is a 5½-lb Nitramite unit. The 9-in. holes in ore and waste carry respective powder loads of 400 lb and 450 lb and one primer, while the 6¼-in. holes in waste only about 130 lb and one Nitramite primer. Powder load and position of primer are shown in the figure. Each foot of 9-in. hole accommodates about 30 lb of diesel-oil-treated ammonium nitrate. The figures for the 6¼-in. hole is 14 lb.

This operation is carried out by a crew of 5 men consisting of a truck operator, helper, and three powder

9 **REMAINING** powder bags are poured in on top of the one primer. Hole is topped with drill cuttings and tamped.

10 **TRUNK LINE** of Primacord is strung along loaded row; loose ends from primers set in holes are attached.

11 **CHARGE** is detonated in record time, with increased safety of operation and full consumption of explosive.

12 **EXCELLENT FRAGMENTATION** has eliminated secondary blasting costs. Shovel and dozer move back in.

men. The men carry out the task of loading a row of drilled blastholes in record time and with a minimum of lost motion. It is an assembly line technique applied to blasthole loading, with each step done in proper sequence and coordination. About 20,000 lb of explosives are loaded in this manner. Here is how it is done.

"Assembly Line"

The first step involves unloading the required number of powder bags from the truck and placing them around each hole to be loaded. When this has been done, an operator slashes open the top of each bag, followed immediately by another man who pours diesel oil, in the quantity mentioned above, into each bag. Next, two bags are poured into the hole. A powder man then attaches the Nitramite primer to the end of a roll of Primacord and lowers it into hole, cutting the Primacord about 2 ft above the mouth of the hole. This is followed by pouring the remaining powder bags into the hole and filling the empty portion near the top of the hole with drill cuttings. After all holes have been loaded, the Primacord trunk line is strung by one powder man and the loose ends of the Primacord projecting from each hole tied into it. This man then carries out the end steps which involve placing a 9-millisecond delay into the Primacord trunk line between each hole, attaching a pig tail with electric blasting cap made from a piece of Primacord from 2 to 3 ft long, to the firing end of the trunk line, and stringing electric wires from the pig tail to the battery-operated blasting box situated at a safe distance from the blasting site. The last two tasks are carried out after the blasting site has been cleared of equipment and men. It will be noted that during this period only one powder man is active in the blasting area. The blast is set off by the conventional plunger blasting box.

Successful Operation

Ammonium nitrate blasting has proved successful at the Berkeley pit. Good fragmentation has been obtained in both ore and waste blasting. No secondary blasting has been required so far. This has meant a greater number of payload swings for the shovels with consequent higher stripping rate and over-all lower mining costs. Experiments under way promise additional savings and possible new applications for this method of blasting.

SOUTHERN CALIFORNIA Edison Co.'s plant became the first non-military atomic energy reactor to produce power for the generation of electricity by a private utility, on July 12 of this year. The plant was dedicated on Nov. 14.

First Private Nuclear Reactor Produces Commercial Atomic Power

On July 12, 1957, Southern California Edison converted the steam from its experimental nuclear reactor at Santa Susana into electrical energy —and, in so doing, became the first private power company to produce commercially distributed power from a non-military reactor. The 7,500-kw plant operates on steam produced by a sodium-cooled reactor.

At the official dedication of the plant on Nov. 14, the company's president, Harold Quinton, said, "Although our atomic generating plant is experimental in nature, and of relatively small size, we hope to learn from it much that will be of use in planning full-scale nuclear power plants in the years ahead." Quinton expressed belief that atomic power may approach the cost of conventionally produced electricity within the next decade, and that within 20 years atomic power may be producing "a significant amount" of the nation's total power supply. Importance of uranium fuel was emphasized by the estimate that 10 lb of uranium can generate as much power as 2½-billion gal of fuel oil—which is the amount used by Edison in a single day's operation.

Edison will share its findings with other utility operators in pursuit of the common goal of developing for the U.S. the most efficient and advanced methods of producing electrical energy to be found anywhere in the world.

Dedicatory speaker Lewis L. Strauss, chairman of the U. S. Atomic Energy Commission, predicted "By the mid 1960's there are expected to be some 18 or 20 nuclear power plants serving homes and industries across our nation. These plants will represent a total investment of close to a billion dollars with a large portion of that sum to be supplied by industry itself. In fact, planning or negotiation has already been announced for eight large plants to be financed by private capital."

The reactor is a sodium-cooled, graphite-moderated type. Heat from nuclear fission, which releases energy through the splitting of atomic nuclei, is transferred to liquid sodium which circulates through the "core" or heart of the reactor. The hot sodium is then pumped to an exchanger where the heat is transferred to a nonradioactive sodium circuit. From this circuit heat may be either dissipated to the atmosphere or to the Edison generating equipment where it is converted into electricity. The reactor is "moderated" by graphite—that is, the neutrons released during fission are slowed down by graphite to sustain the fission process.

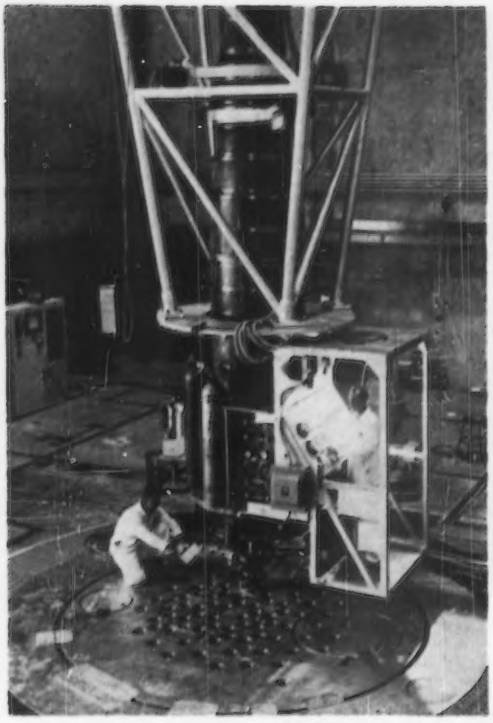
Development of fuel elements and various combinations of fissionable materials for the reactor core is an important phase of the program. The reactor uses uranium slightly enriched in uranium-235 in the core. Cores using thorium-uranium alloys are planned for future study, and various other materials, components and structural assemblies will also be investigated in the reactor.

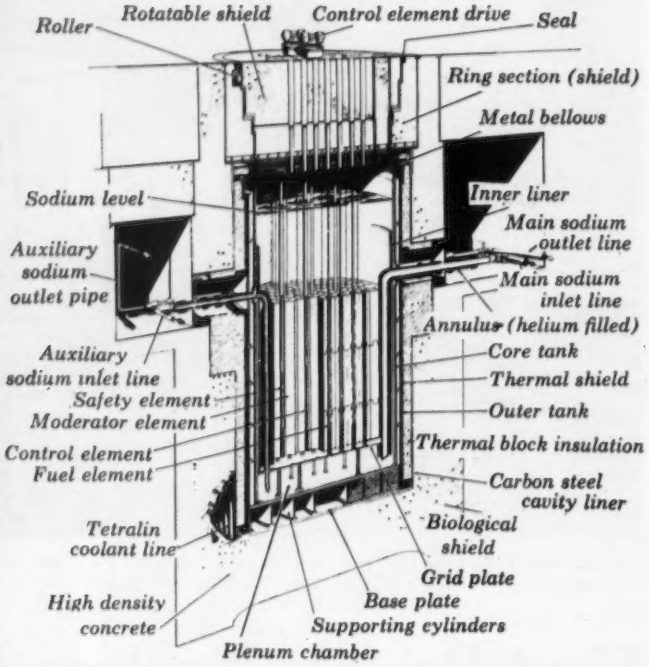
Characteristics of sodium which make it particularly suitable as a reactor coolant are the metal's relatively low neutron absorption qualities, good heat transfer properties, low melting point and high boiling point. Use of sodium permits production of high temperature without high pressure.

The reactor, including the core and cooling sodium, is encased in a steel tank. This entire unit is installed underground, with five feet of dense concrete between the reactor and ground level.

Boron-nickel control rods regulate the fission rate of the reactor by absorbing neutrons. Safety elements serve to stop fission and shut down the reactor as required.

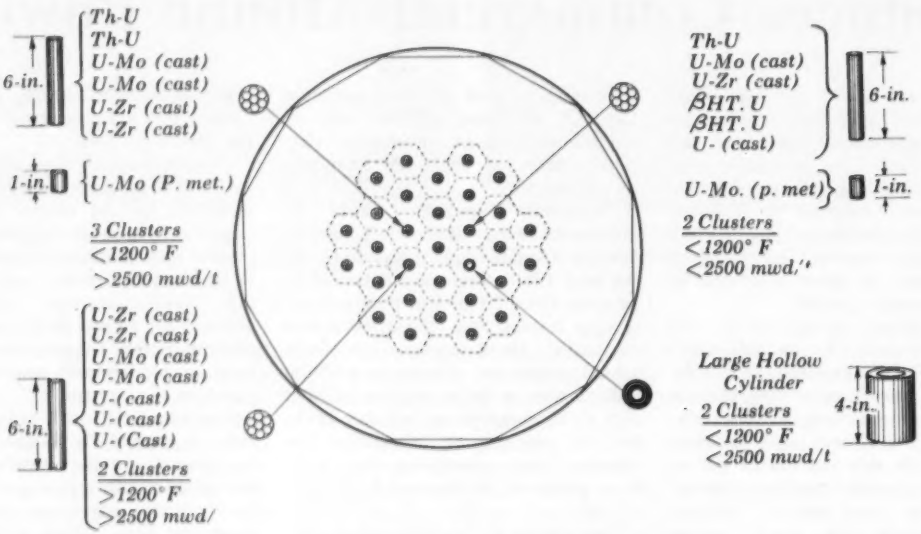
Contract funds for the Sodium





SCIENTISTS of Atomics International load uranium fuel into heart of Edison's atomic power reactor.

CORE SECTION reveals fuel elements, control elements, safety elements, shielding and system for circulating sodium coolant.



VARIOUS FUEL ELEMENTS will be tested in experimental reactor. Ceramic fuels will also be included. Data on thorium-uranium elements are expected to supply valuable clues to operation of a successful thermal breeding cycle.

Reactor Experiment total $16,733,000 to June 30, 1957. Atomics International, a division of North American Aviation, Inc., is assisting in financing the AEC project by contributing $2,850,000 of this amount. Research and development costs, which account for the largest portion of the over-all project costs, amount to $8,945,000.

Major suppliers of equipment and contractors for the project include: Byron Jackson, pumps; General Electric Co., turbine generator; Ingersoll-Rand Co., condenser; Macco Corp., construction; C.C. Moore & Co. representing Babcock & Wilcox Co., steam generator; Permutit Co., demineralizer and water-treating float; and Santa Fe Tank Div. of Fluor Products Co., cooling tower setup.

As originally designed, the reactor was to operate at 20,000 thermal kilowatts which was to be dissipated to the air in a sodium-to-air heat exchanger. However, Southern California Edison Co. has since erected a steam generator and turbine generator facility to convert the reactor heat into about 6,500kw of electricity.

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Heavy tools can drop on it. Pieces of rock from blasting can strike it. It can be pulled over jagged stones, grinding gravel—in all kinds of weather. *Throughout all this, U. S. 4810 stays unharmed, delivers full service.*

U.S. 4810 combines super adhesion and extreme flexibility. The rugged service that this hose provides throughout its long life proves that you are wasting dollars if cheaply constructed, short-lived air hose is being used instead of U. S. 4810 Air Hose.

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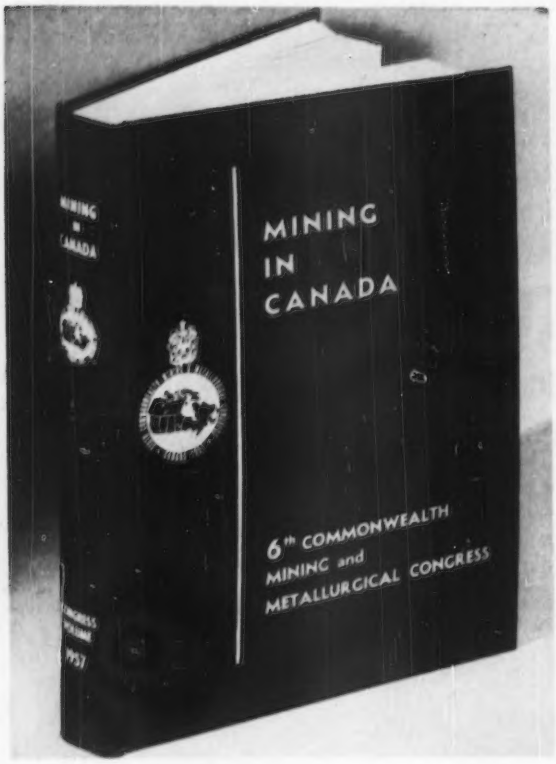

CIMM Publishes First of Series

Mining in Canada. This excellent volume is a joint effort by the Metal Mining and Coal divisions of the Canadian Mining Institute of Mining and Metallurgy for the occasion of the visit to Canada of the Sixth Commonwealth Mining and Metallurgical Congress. At the request of the Institute, International Nickel Co. assigned to members of its staff the task of compiling the articles that appear here. Text includes chapters on—shaft sinking, drifting, raising, mining methods (open pit, trackless and caving, blasthole mining, shrinkage stoping, cut-and-fill, square set, benching, etc.). Stope filling, dredging for gold and at Steep Rock Lake, drilling practice, explosives, ground support, rockburst control, mine ventilation and fire control, hoisting, haulage, materials handling, drainage, pumping, safety, mine data and coal mining in Canada are also included. Published by Sixth Commonwealth Mining and Metallurgical Congress, 507-837 West Hastings St., Vancouver, B. C., Can. Illustrated in 597 pp. Excellent. Price—$10. Additional volumes will be prepared on geology, milling, geophysics and industrial minerals.

Uranium Symposium Notes

Recent Developments in Uranium Milling Technology (not shown). This is a transcript of the mill technology symposium held at the annual meeting of the Uranium Institute of America in Denver, Colo., 1957. Includes the latest information on—Dapex Process, ion exchange, lignite processing, solvent extraction, thorium's place in the future, and the industrial atom. Published by the Institute, Uranium Center Bldg., Grand Junction, Colo. 105 pp. Illustrated. Price $5.

Canada—Principal Mineral Areas Map—900A, 7th edition. Contains principal mine locations, regional geology, smelters and refineries. On scale of 1 in. to 120 miles. Published by Department of Mines & Technical Surveys, Ottawa, Ont., Can.

Metallurgical Works in Canada—List 1-1, Part I, Primary Iron and Steel. Published by Mineral Resources Division and Mines Branch, Department of Mines & Technical Surveys, Ottawa. 31 pp. Price—25c.

Survey of Gold Mining Industry in Canada during 1956, by Thomas W. Verity. Published by the Department of Mines & Technical Surveys, Ottawa. 55 pp.

Ontario Department of Mines Vol. LXV, Part 3, Geology of the Sudbury Basin, by James E. Thomson. Volume also contains two other articles by Howell William and T. C. Phemister. Maps and illustrations in 116 pp.

Canadian Mines Handbook—1957. Covers principal companies and their activities plus metal mining area maps. A ready reference to the mining activity in Canada. Published by Northern Miner Press, 116 Richmond St. West., Toronto, Ont., Can. 324 pp. Price $3.

Minerals, Canadian and the World. Published by Mineral Resources Div., Department of Mines & Technical Surveys, Ottawa. Report No. 860. Contains individual and world maps for each commodity showing metal or mineral flow. Also has special Canadian maps showing location of deposits. This is a companion piece with *Statistical Supplement* containing charts, graphs and tables. Price $1.

Digest of the Mining Laws of Canada, 5th edition, by H. A. Granes and G. R. L. Potter. Report No. 854 by Mines Branch, Department of Mines & Technical Surveys, Ottawa. 148 pp. Price $1.

Canadian Mining Manual—1957. Flowsheets, data on mining and milling operations, index to suppliers, classified equipment index, and technical articles. Published by *Canadian Mining Journal*, National Business Publications Ltd., Gardenvale, Que., Can. Price $8.

Report No. G. R. 75, Northern Quebec. Geologic report in the iron ore regions and recent interesting discoveries of other metals. Prepared by Department of Mines, Province of Quebec, Montreal, Que., Can. Map included.

Mineral Map of Ontario. Published by Ontario Department of Mines on scale of one inch to 20 miles. Shows major mining areas and regional geology. More than 15,000 names are shown. In eight colors. From Department of Mines, Toronto, Ont. Price $1.

Milling Plants in Canada, List 1-2, Part I, Metallic Ores. Prepared by Mineral Resources Division, Department of Mines & Technical Surveys, Ottawa. Simple, concise list of all metal mines in Canada with milling plants by commodity and Province. 35 pp. Price 25c.

Porphyry Coppers in 1956, by A. B. Parsons. Brings up to date the Rocky Mountain Fund Copper series. Here are a few items from the book: Utah Copper raised copper recovery from 92 to 93% in 1954 and increased their income by $2-million. In addition, the installation of a moly plant added another $1.8-million in income from a relatively simple process change. During 1952-1953, Utah spent $3.8-million to redesign the flowsheet. In 1954, mining and milling costs were 23.7c for Andes Copper, 23.5c for Inspiration and 19.5c for Miami. Published by AIME. Illustrated in 261 pp. Price $5.

Bulletin No. 39, Metal Resources of New Mexico and Their Economic Features Through 1954, by Eugene C. Anderson. Published by State Bureau of Mines and Mineral Resources, Institute of Mining & Technology, Campus Station, Socorro, N. M. 170 pp.

Quin's Metal Handbook, 1956-57. Contains 704 pages crammed with vital statistics on metals, both ferrous and nonferrous. Published by Metal Information Bureau Ltd., Birkett House, 27, Albemarle St., London, W 1. Price 25s post free.

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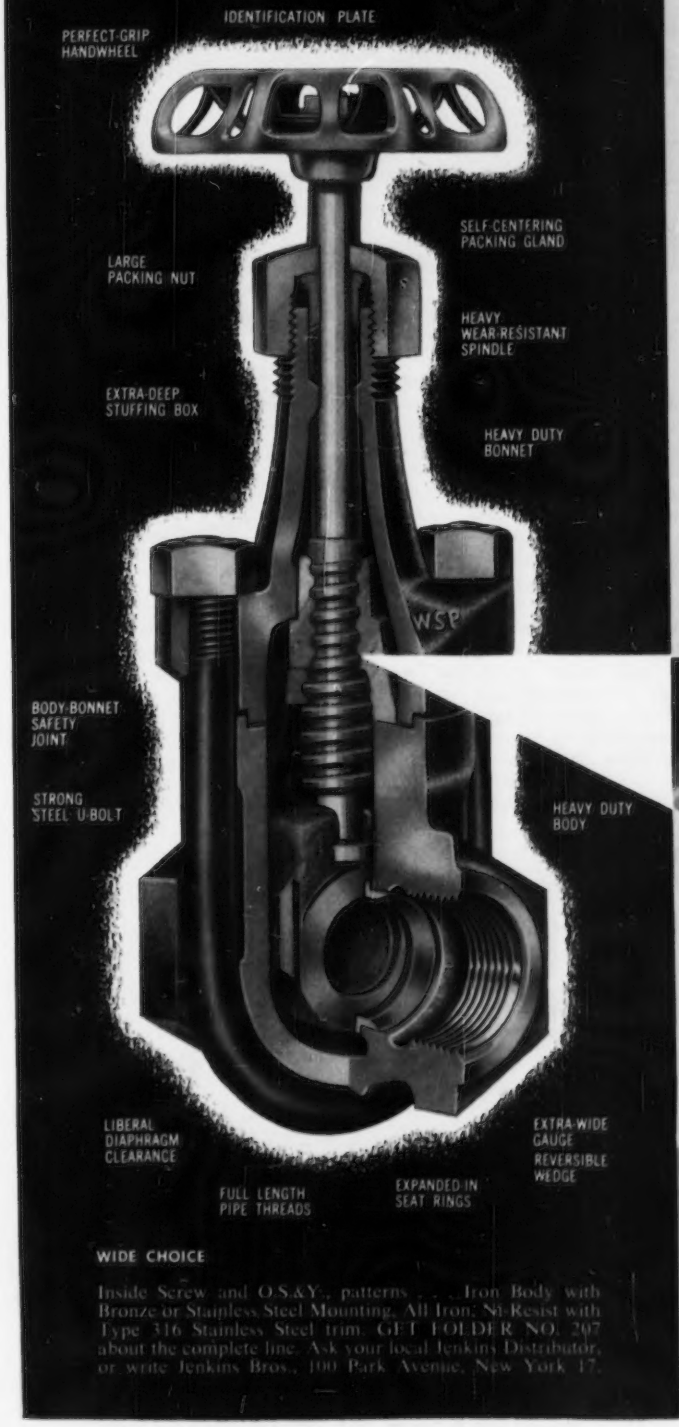
JENKINS U-BOLT GATES

has all these dollar-saving features



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Inside Screw and O.S.&Y., patterns . . . Iron Body with Bronze or Stainless Steel Mounting. All Iron; Ni-Resist with Type 316 Stainless Steel trim. GET FOLDER NO. 207 about the complete line. Ask your local Jenkins Distributor, or write Jenkins Bros., 100 Park Avenue, New York 17.

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Built right into a Jenkins U-Bolt Gate Valve are dollar-saving features no other can match. Construction superiorities that equip this valve to take punishment longer . . . saving dollars in replacement bills. Features that cut maintenance time and the cost of replacement parts . . . saving more dollars. For a good example, look at the unique Renewable Bonnet Saver Bushing which is a patented feature of Inside Screw valves.

BONNET-SAVER BUSHING

No need to junk a bonnet with worn operating threads. Just slip in a new bushing for good-as-new thread engagement . . . saving bonnet and lengthening spindle life.

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LOOK FOR THE JENKINS DIAMOND

VALVES

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OPERATING IDEAS

Tips On Using Crawlers in Rocks

USING CRAWLER-TRACTORS in rock work presents operating conditions and wear characteristics which are quite different from those encountered in routine dirt work. Service life of track shoes, rollers, idlers, links, bushings and final drive sprockets is usually considerably shorter.

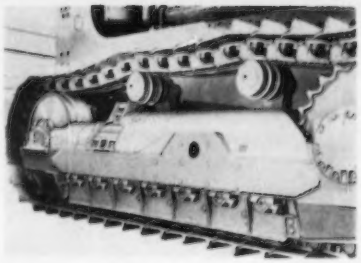
Track shoes are the first consideration. Though ideal for operations in mud and gumbo where flotation is the prime consideration, wide shoes fall short in rock work. Wide track shoes have greater "overhang" beyond the track link than narrow shoes, thus more leverage is placed against the outer edges and this causes them to be more frequently damaged while working in rock.

When crawler tractors work almost exclusively on hard surfaces, double grouser track shoes should be used. In addition to offering better wearing qualities, the second grouser strengthens the shoe longitudinally, providing much greater resistance to bending or cracking under rock work's heavy impact.

Idlers, if two-position, should be adjusted so that they are in "low" only when necessary for the job at hand. With idlers in the low position, track shoe grousers wear rapidly.

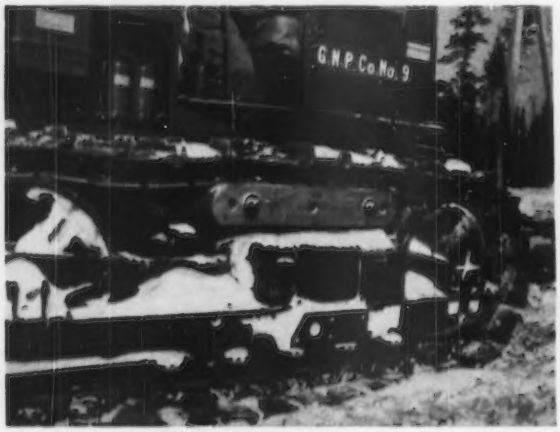
Track roller guards, according to Caterpillar Tractor Co.'s field experience, effectively protect the component parts of the track and provide maximum service life. Tractors not equipped with roller guards suffer when rock feeds in between the rollers and track, causing a "rock crushing" action to be set up when machine moves either forward or back. As it moves backward, rock also gets between the idler and track, and as it moves forward, sprocket and track act as the crushers.

Such crusher action alone can reduce service life of tractor's parts. If, moreover, this occurs on a track that's adjusted too tightly, the results become disastrous. Tight track absorbs horsepower, robbing the tractor of its full productivity and may result in damage to the final drives. Tendency to 'stretch out' the track causes unnecessary wear and strain on the track links, pins and bushings. Track recoil mechanism is designed so the sprocket can, under some conditions, jump a tooth and reduce the possibility of severe damage to the final drive. But when too much rock finds its way into the track, the recoil mechanism cannot allow sufficient movement of the idler to feed the rock through.



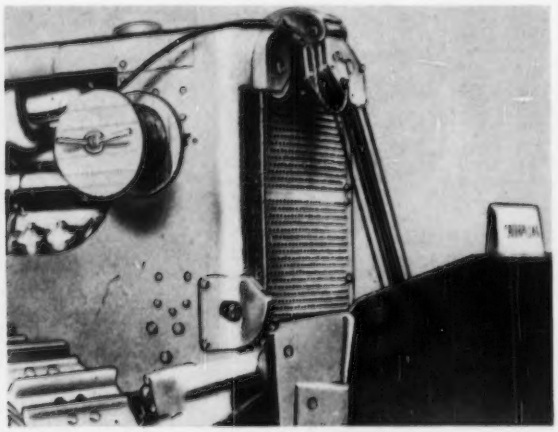
Guards also help to hold tracks on the rollers in rugged and steep slope terrain, reducing wear on the roller flanges and idler pilot rim.

The final tip concerns maintenance: Recondition track parts before they have worn beyond recommended limits, as it is important for economical operation in fine abrasive rock.



Wood Block Cuts Maintenance

MUD AND ICE-CLOGGED TOP IDLERS are no problem if they are replaced by wood block as on tractor at Great Northern Paper Co., Greenville, Me. Gadget wears for entire season, according to Harry Weber, shop superintendent—*from International Harvester news release.*



Spare Reel Of Cable Cuts Costs

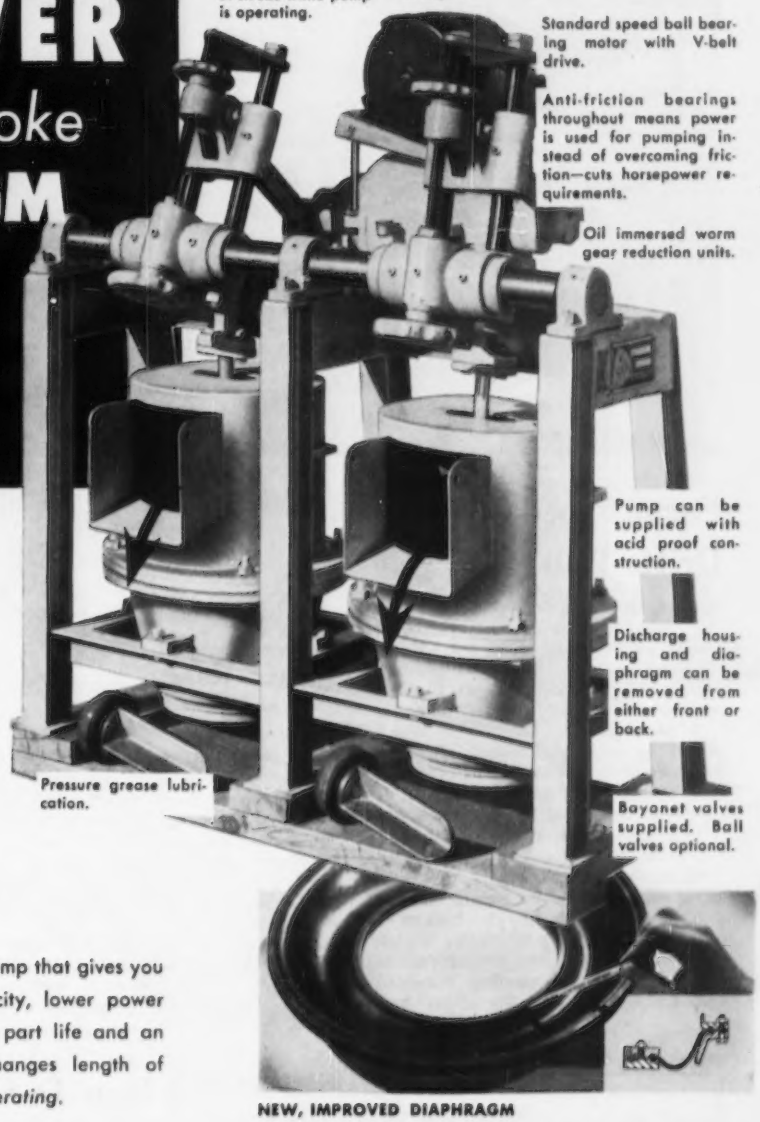
REPLACING CABLE, damaged or broken, on a dozer blade hoist, is cheaper, quicker and easier with hood-mounted reel holding excess continuous rope. To use: loosen wedge pocket and, from winch end, pull through only required replacement. Reel bracket can be simple pipe fittings.—*Caterpillar News.*

MODEL E DENVER *Adjustable Stroke* DIAPHRAGM PUMP

SIZES TO 10" DUPLEX

Simply turning an accessible handwheel adjusts length of stroke while pump is operating.

New compact drive design requires less headroom, makes installation easier. Use of steel frame reduces weight, increases strength.



Standard speed ball bearing motor with V-belt drive.

Anti-friction bearings throughout means power is used for pumping instead of overcoming friction—cuts horsepower requirements.

Oil immersed worm gear reduction units.

Pump can be supplied with acid proof construction.

Discharge housing and diaphragm can be removed from either front or back.

Bayonet valves supplied. Ball valves optional.

Pressure grease lubrication.

Stroke can be adjusted ***While Pump is Operating***

Improved Design... Boosts Capacity over 50%

Cuts Horsepower Requirements

Here's an improved, low cost diaphragm pump that gives you these important benefits: increased capacity, lower power requirements, ease of installation, longer part life and an improved handwheel adjustment that changes length of stroke, alters pulp flow *while pump is operating.*

Wherever you need a pump to regulate the flow of pulp—for pumping filtrates, metering flotation feed or regulating thickener underflow—compare specifications FIRST—and you will agree a DENVER Adjustable Stroke Diaphragm pump is your BEST VALUE.

For full details write for Bulletin No. P8-B11

NEW, IMPROVED DIAPHRAGM

- **This new, improved design makes possible a longer stroke and up to 75% higher capacity. Improved design also increases life of diaphragm.**
- **Molded rim evenly distributes tension to entire circumference.**
- **Diaphragm is clamped in place so there are no holes to weaken diaphragm.**
- **Molded rim means faster, simpler replacement. Only 6 bolts to take out to remove yoke-diaphragm unit from pump.**
- **Rubber diaphragm molded with nylon cord has a true catenary curve throughout the stroke, adding greatly to operating life.**

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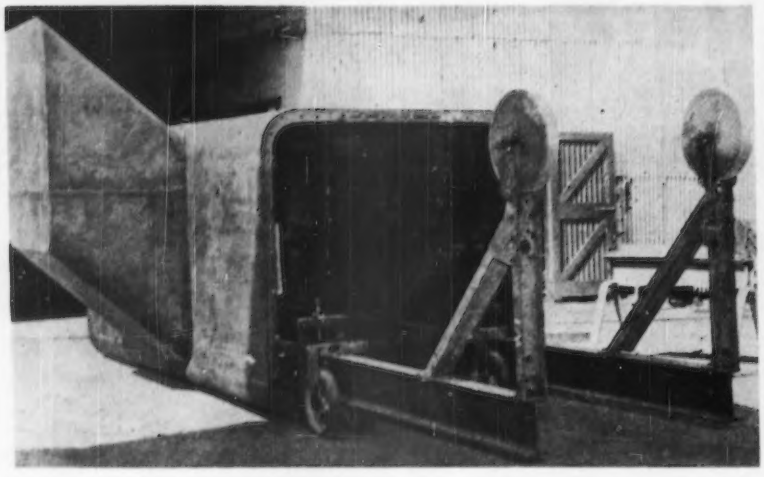
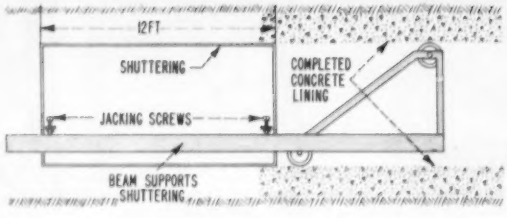
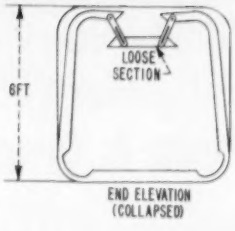
OPERATING IDEAS *(Continued)*



Form Speeds Lining Drifts With Concrete





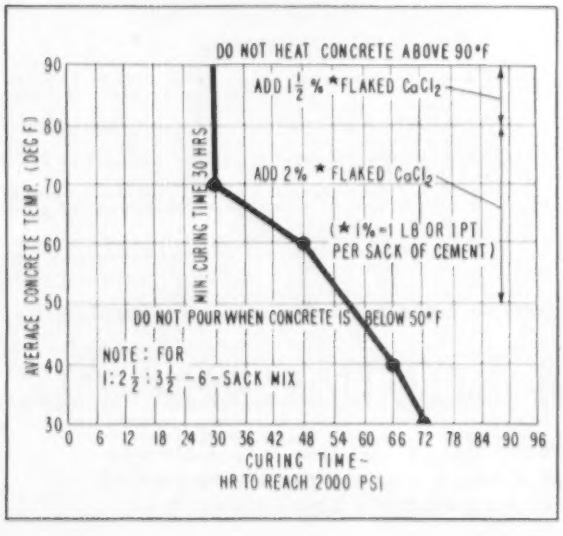
MOBILE "SHUTTERING" (concrete forms) that need not be dismantled, enable scraper drifts to be lined with greater efficiency at De Beers Consolidated Mines, Ltd., Kimberley, Union of South Africa, according to "Optima" magazine.

A complete oblong steel shell is supported by two steel beams fitted with rubber-treaded wheels. These wheels bear against the floor and roof of the completed lining and hold the form firmly in place, as well as enable the entire unit to be moved forward.

Shuttering is freed simply by loosening a top panel and by pulling the sides inward, using screw-jacks. Bottom is freed by raising the shuttering slightly on its supporting beams, also with screw-jacks. No further dismantling is needed, and once the above operations have been carried out, the shuttering can be moved forward to the next position with a minimum of effort. When it has been correctly positioned for the next pour, side frames are returned to "true", the loose roof panel is bolted on and the masking which blocks off the concrete at the front of the shuttering is fixed in position.

A tunnel 5 ft wide by 7 ft high is enlarged to 12 ft sq before lining with 2.5 to 3.5 ft of concrete. With old method, "sliping" (stripping) had to be 30 ft in advance of the completed lining. Now it can be reduced to 20 ft, with danger of falling ground further minimized by a shorter time lag between stripping and pouring.

Previously, floor was poured first, after which the shuttering was moved forward to the newly laid floor and re-erected for the molding of the roof and walls. With this older scheme, apart from the labor considerations, there was always the possibility of weakness in the bonding where floor and sides met.


DO NOT HEAT CONCRETE ABOVE 90°F
ADD 1½ % * FLAKED CaCl2
ADD 2% * FLAKED CaCl2
(* 1% = 1 LB OR 1 PT PER SACK OF CEMENT)
MIN. CURING TIME 30 HRS.
DO NOT POUR WHEN CONCRETE IS BELOW 50°F
NOTE: FOR 1:2½:3½ - 6 - SACK MIX
AVERAGE CONCRETE TEMP. (DEG F)
90
80
70
60
50
40
30
0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96
CURING TIME - HR TO REACH 2000 PSI

How To Cure Concrete In Winter

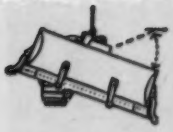
TO PROPERLY CONTROL **concrete curing** time in sub-zero weather, crews of O. W. Walvoord, Inc. (Denver, Colo. construction firm), working in Northern Michigan and in the Colorado Rockies, have developed a general set of rules.

If concrete freezes before curing is complete, it will not set up, and becomes worthless. On the other hand, protecting it from freezing beyond the required curing time delays work and makes costs excessive. According to Walvoord, with the following rules, "every pour measures up to required strength at a reasonable cost":

1. Take temperature of concrete in form at time of pour and every 6 hr thereafter, by inserting a thermometer in hole.
2. Average the readings progressively and determine from graph required time during which freezing must be prevented by covering and/or heating with salamanders or other means.
3. After curing time has elapsed:
   a) Stop heaters and leave canvas in place 24 hr.
   b) Leave forms in place for 48 hr after curing time.
   c) Do not permit surface temperature of concrete to drop faster than 40 deg in any 24-hr period.

Notes: a) Do not use water heated above 140 deg F.
b) Do not use aggregate heated above 200 deg F.
c) Add $CaCl_2$ to aggregate, not to dry cement.

NEW! THE CAT* NO. 7G BULLDOZER



Blade tilts 3′ to either side!

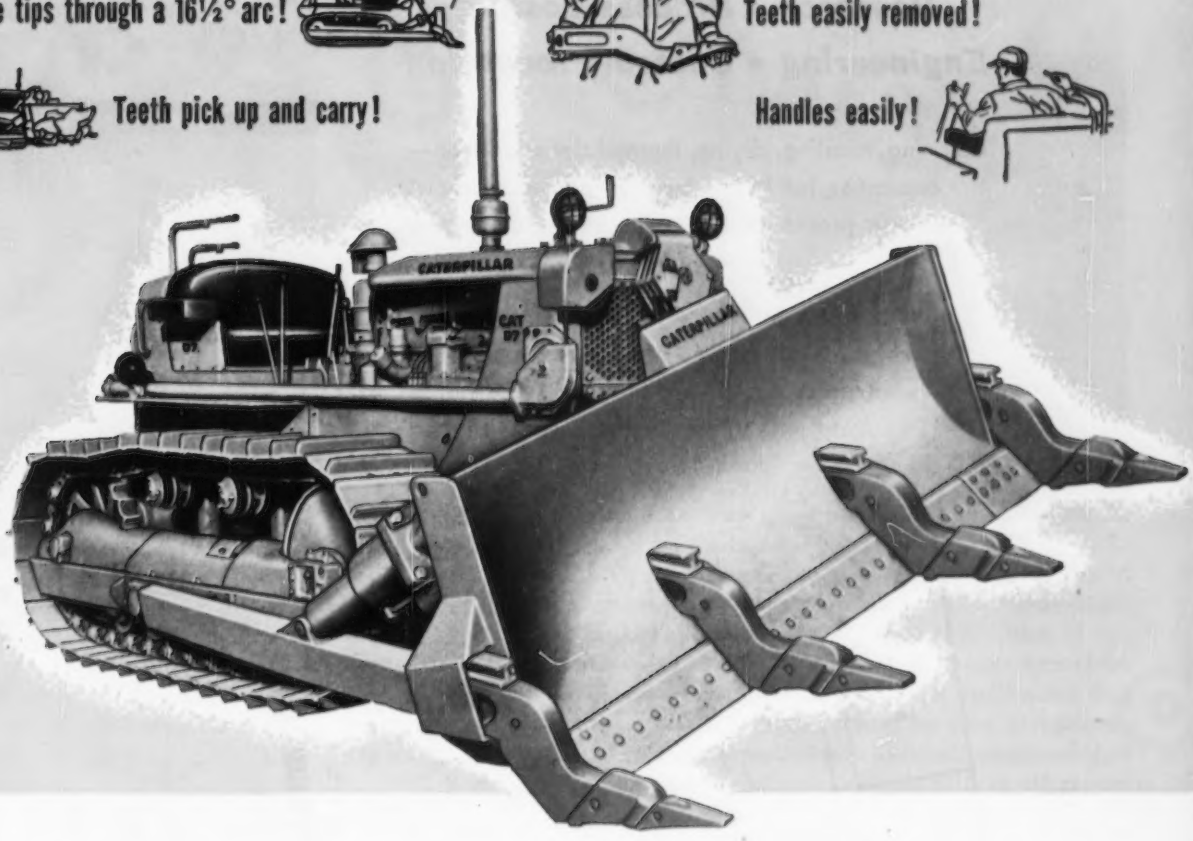
Teeth slice through hard materials!

Blade tips through a 16½° arc!

Teeth easily removed!

Teeth pick up and carry!

Handles easily!



'DOZER AND RIPPER IN ONE

The brand-new Caterpillar No. 7G Bulldozer is a completely different type of bulldozer. The amazing tilt-tip action, and its four heat-treated cast steel teeth, are an entirely new concept in 'dozing. The Gyrodozer is both a 'dozer and a ripper.

YOU'LL GET HIGHER PRODUCTION

The Gyrodozer rips through hard or frozen materials. Its 23″ teeth not only pry out boulders but pick 'em up and carry 'em away. In rocky soil, the wedging action of the teeth surfaces small rocks for scooping up by the 10′ 10″ blade. On the really tough jobs, the tractor's full horsepower can be put behind a single tooth. The Gyrodozer is ideal for uprooting trees and clearing an area in a hurry.

EASY TO OPERATE

A Cat No. 25 Cable Control raises and lowers the 'dozer and a front-mounted No. 44 double-valve Hydraulic Control tips and tilts the blade. The operator never needs to leave his seat to make a blade adjustment.

GET FULL DETAILS

on the revolutionary new Gyrodozer from your Caterpillar Dealer.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR*

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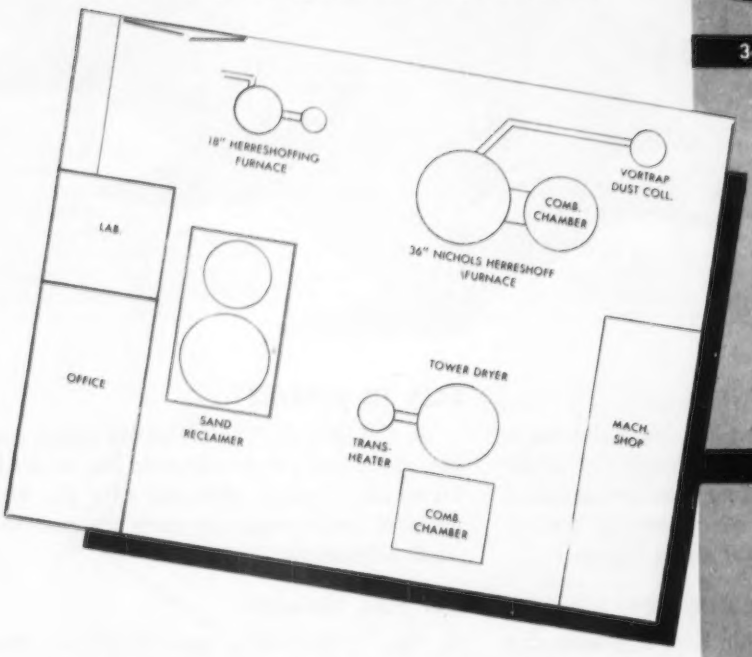
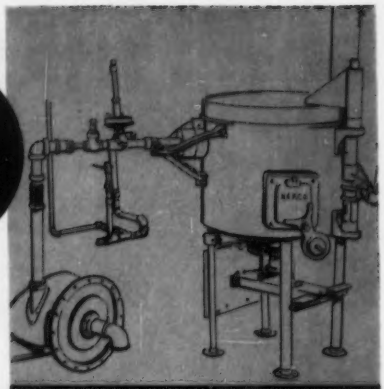
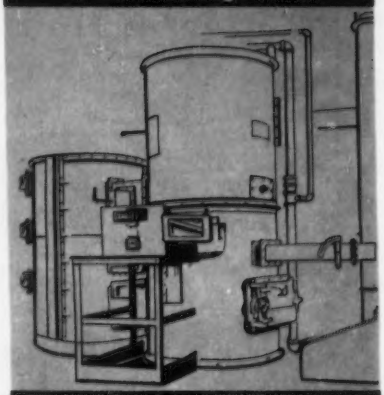
Calcining, roasting, drying, thermal decomposition—capacities, ten to one hundred pounds per hour. Test your process on pilot scale before embarking upon a more ambitious project.

Tell us your problem—what materials you are working with—what kind of products you wish to make—what process steps are involved. We will be glad to help you. Nichols laboratory and engineering staff are at your service.

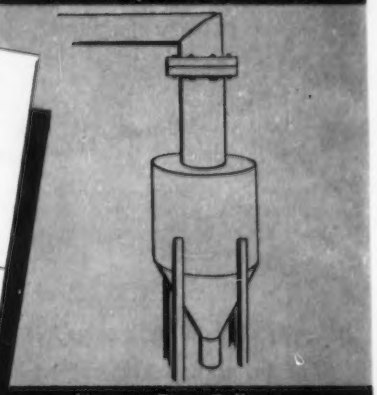




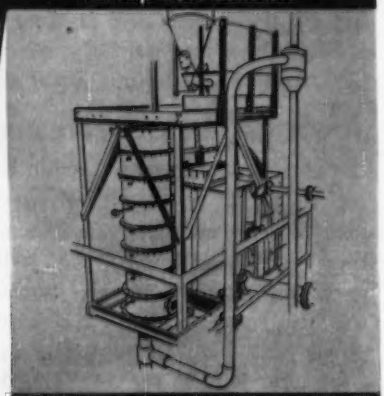
18" Herreshoffing Furnace



36" Multiple Hearth Furnace



Vortrap Dust Collector



Tower Dryer and Transheater

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The use of Twin-Power in earthmoving equipment, developed and pioneered by Euclid, has enabled contractors, mines, quarries and industrial operations to make a far better return on their equipment investment. With two engines, each having a separate power train, bigger loads are moved faster and at lower cost . . . with only one operator.

Euclid's Twin-Power Scraper is a good example of this advanced engineering. With struck capacity of 24 cu. yds.—and 32 yds. heaped—this machine can work independently without the pusher tractor assistance required by conventional scrapers. All wheel drive, powered by two engines providing a total of 518 h. p. through two Torqmatic Drives, gives this "Euc" unequalled work-ability. "Twins" have established new records for high production at low cost on a wide range of work.

Twin-Power performance pays off in other Euclid equipment, too—crawler tractors and in rear-dump haulers of 40 and 50 ton payload capacities. If you use earthmoving equipment in your operations, Euclid Twin-Power may have an application that will produce a higher return on your investment. Complete information with technical assistance of an equipment specialist is available without obligation.

EUCLID DIVISION • GENERAL MOTORS CORPORATION • Cleveland 17, Ohio

Euclid Equipment

FOR MOVING EARTH, ROCK, COAL AND ORE

WASHINGTON IMPACT

Highlights

LEAD-ZINC TARIFFS—Look for the Tariff Commission's decision on new import protection for domestic lead and zinc producers in about six weeks. As the industry's emergency committee presented its case last month (see story on hearings this page), Washington expected the trade board and the White House to approve boosts up to the legal 50% limit on duty rates for metals, probably for ores and concentrates as well, but not for products or semi-manufactures. The request for quotas will likely be rejected by the White House, if not by the Tariff Commission.

FOREIGN TRADE—The lead-zinc tariff case is a bellwether. How it is decided will be a good tip-off as to how far the Administration is willing to modify its liberal international trade policy to protect domestic metals and minerals. If lead-zinc wins, others such as copper and tungsten will be sure to follow up with appeals for new import protection themselves.

The Administration is walking its own special razor's edge on trade policy. When the Reciprocal Trade Agreements program comes up in Congress for review and extension early next month, it will face the toughest protectionist opposition in a quarter-century. Protectionists want new administrative relief from liberal trading, say they will write specific import quotas into the law or defeat it outright if they don't get the amendments they want. Liberal traders on Capitol Hill fear the White House may grant more administrative relief from import competition to domestic industries in an effort to forestall emasculation or defeat of the trade laws. But, support for a liberal trade program will strengthen in the wake of post-sputnik concern over keeping the economies of western allies healthy.

ALUMINUM SUPPLY—Major aluminum producers told a House Small Business Subcommittee investigating availability of the metal for small, non-integrated independent users that there will be plenty of the metal around for all takers for the "forseeable future."

The Subcommittee is in the interesting position of investigating a market condition completely opposite of the one that spurred the probe. Back in 1955, small users complained they weren't getting enough metal, charged that big makers' long-term contracts with big users shut them out. Now supply has gone far ahead of demand.

But the House Committee still wants to watch out for small users. It quizzed the big three auto makers on what they are doing to develop new uses for aluminum, and how much they order from small suppliers. Chrysler Corp. said it gets most of its parts from small suppliers. But the big three aluminum makers defended long-range contracts with big suppliers on the grounds they need that stability to finance their own market and production expansion.

In a separate report filed with the Subcommittee, Aluminium Ltd. of Canada said small users are getting over half the Canadian imports of the metal.

BARTER—While the Government's program of bartering domestic crop surpluses for foreign metals and minerals has been severely cut back, its similar plan of exchanging crops for foreign currency may be expanded from a $4-billion top limit to $5- to $6-billion. This would take Congressional authorization, which the White House would ask on grounds of aiding dollar-poor allies. The foreign currency received in exchange for the crops may be used, among other things, to purchase foreign metals and minerals. Therefore, if this program is expanded, it may more than make up for the cutback in barter.

Barter, meanwhile, continues to run far below the levels it set before its regulations were restricted. Contracts negotiated during the third quarter 1957 total $400,000 worth of foreign strategic materials, compared to $20.4-million the previous quarter, $54.7-million for the first quarter, and a high of $62.5-million for the third quarter last year.

Lead-Zinc Hearings Get Specific Quota Request

IN A JAM-PACKED HEARING ROOM that soon reflected both the heat and interest of the debate it housed, domestic lead and zinc producers late last month made their pitch to the Tariff Commission for new tariff and quota protection against imported ores, concentrates, and metal.

From the outset, the domestic mining industry's Emergency Committee, headed by Charles E. Schwab, admitted it was not in unanimous agreement on the need for quotas as well as import duty hikes. Under cross-examination from the attorneys representing such opponents of additional import restrictions as American Smelting and Refining Co., Cerro de Pasco, and foreign importers, Schwab declined to say how the Committee was split on this issue. He later said a majority favored quota restrictions, because higher tariffs would not bring adequate relief.

Outside the hearing, veteran Washington tariff experts expressed surprise that the Committee submitted specific recommendations for quotas. The usual procedure in Tariff Commission cases is for the petitioner to request tariff and quota protection, without spelling out technical standards which the Commission feels is its own function to work out. The Emergency Committee's specific request for quotas tied to the difference between domestic production and domestic consumption therefore was not expected to carry too much weight with Commission.

Another key factor in the case was the opposition of smelters, refiners and processors, led by AS&R. They argued that domestic producers can find all the markets they need with processors, but not at the prices the mines tend to set.

Still another side of the case indicated serious complications the Tariff Commission faces in defining what forms of lead and zinc may be included in any recommendation for higher tariffs. Brass and copper manufacturers, through the Copper and Brass Research Institute, testified that copper and zinc contained in brass imports would not be subject to higher zinc duties under present consideration, because the Tariff Commission had turned down the Emergency Committee's request that products and semi-manufactures of lead and zinc be included—on the grounds that the committee was not the proper group to make such a request. Further, all copper tariffs have been suspended by Congress. Many brass manufacturers are against new zinc duties, unless they include the zinc in manufactured brass imports. Rolled zinc producers also asked inclusion.

Aside from the unexpected, the hearings dealt with traditional arguments for and against escape clause relief from import injury.

Schwab cited both recent price declines

and production fall-outs as evidence of injury, and noted that this is the third time in eight years that lead and zinc producers have asked tariff relief (the Tariff Commission supported a plea for higher duties three years ago, but it was turned down by the White House). Schwab testified the Emergency Committee represented 130 domestic mines (primarily smaller ones), plus trade associations, which account for 90% of domestic production. If they don't get import protection, he warned, "the industry will be destroyed."

Schwab was supported by other committee members, including Andrew Fletcher of St. Joseph Lead Co., John D. Bradley of Bunker Hill Co., R. L. McCann and Robert L. Kenly of New Jersey Zinc Co., Howard Young of American Zinc, Lead and Smelting Co. (who opposes quotas), and Edward Snyder of Combined Metals Reduction.

Mining, and metal-chemical trade unions also supported the Committee's petition, as did a long list of mining state Congressmen on grounds that imports are causing serious employment layoffs as well as damage to the mining companies.

Arrayed against import restrictions, in addition to AS&R and Cerro de Pasco, were National Zinc Co., Matthieson and Hegeler Zinc Co., American Die Casting Institute, the American Metal Co., Ltd., Blackwell Zinc Co., and representatives of importers of Australian, Canadian, Peruvian, Chilean and Bolivian lead and zinc.

The opponents cited the growing need for dollars in the exporting countries, part of which are used to buy American exports. They also questioned damage to domestic producers, pointing to the wide disparity between American production and consumption.

GSA Denies Complications In Sale of Nicaro Plant

General Services Administration called a special press conference late last month to scotch what it said were false rumors that its planned sale of the Government's nickel plant at Nicaro, Cuba, has hit snags. Special GSA assistant for Nicaro, Ira Beynon, said over 20 U.S. firms have expressed interest in Nicaro, which GSA has up for either sale or lease under conditions set down by Defense assuring adequate U.S. defense supplies.

These conditions include requirements that 75% of Nicaro's production be offered to American industry, and that the plant be controlled by majority U.S. interests. Cuban nationals, however, may participate, as minority holders. Beynon hopes to invite bids formally by the first of the year, and complete the sale for not less than the Government's $85-million investment by March 1958.

Labor This Month

UNEMPLOYMENT ACROSS-THE-BOARD: The heavy lay-off rate that hit the non-ferrous mining industry this year will spread to all industries in 1958. All the predictions point to advancing unemployment—from the mines to the factories, from construction to electrical work. The causes are showing up in the late returns of Government surveys. While the total count near the end of the year falls under 3-million, the months ahead are expected to boost this by one or two million more. Here's why:

- Manufacturing employment has fallen each month through 1957—and there are no signs of a pickup. Right now, the job total in the nation's factories is about half a million behind a year ago.
- Construction cutbacks, especially in home building, are cutting into the number of employed in that industry. This slowdown in building combined with the cold weather seasonal decline will, in itself, bring an impressive rise in the jobless total.
- The trend throughout industry to reduce capital spending means further loss of jobs. Combined with a drop, or readjustment in Federal spending, the unemployment totals will be swelled further.
- The unemployment count at the end of the year is widespread, through all industries. This indicates a reversal of the trend will be hard to stop. A sudden spurt in a key industry wouldn't help all others.

LABOR'S WARY OUTLOOK: Scanning the manpower crystal ball, union leaders don't like what they see. Apart from the immediate impact on their membership, they sense trouble ahead for the bargaining program. It's generally true that when unemployment is high, unions don't fare as well at the bargaining table. Their members are less anxious to strike for higher wages when other workers are outside looking in. And, conversely, management is less anxious to avoid a walkout if their production lines are not running full speed. The lost production in a strike can be made up more easily in this situation.

Unemployment also affects the demands labor will make. It will add to the union pressure for its latest key issue—the shorter work week. This is the number one topic the United Auto Workers' Walter Reuther is bringing into negotiations with the auto industry in the spring of 1958. He'll argue for this as a share-the-work scheme, so more employes can stay on the job. But, while the jobless total adds to Reuthers' argument, it also weakens his position to get what he asks for.

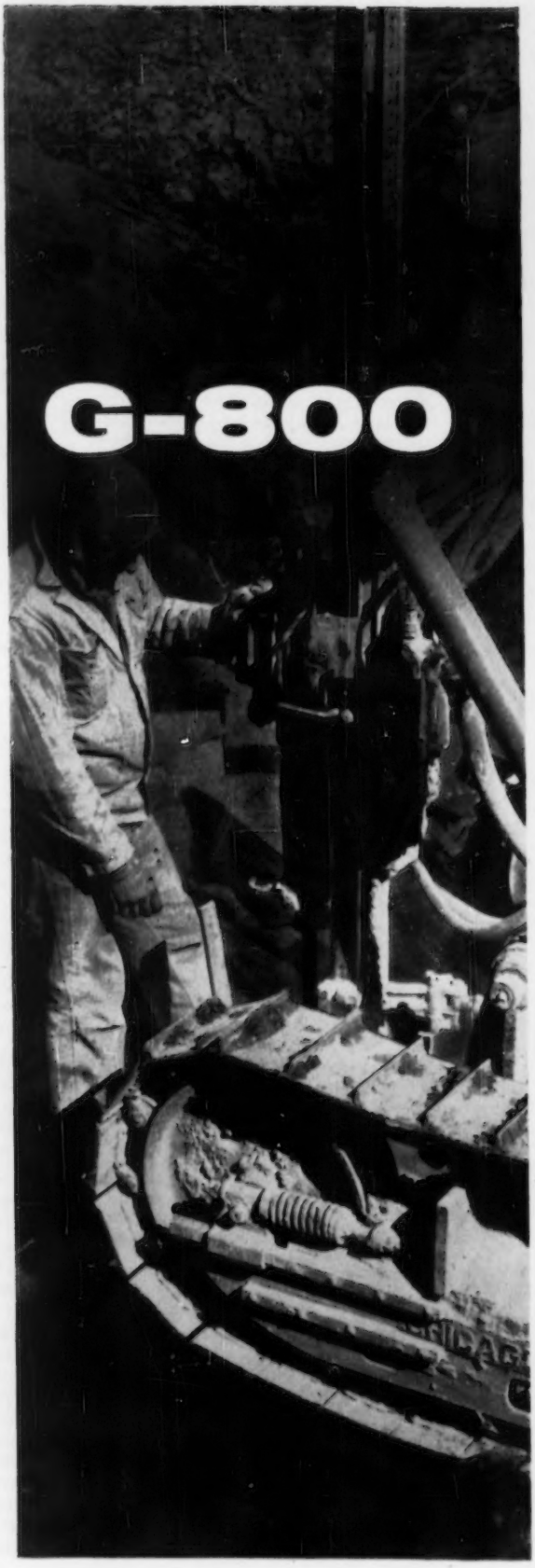
LABOR ORGANIZING CURBED: A series of three key rulings by the National Labor Relations Board is crimping union tactics for rounding up new members—particularly the device of organizing through employers rather than their workers. This has been a favorite strategy in trucking and construction industries. Here's what the board has outlawed:

- Union picketing of an employer for recognition where it does not represent a majority of his workers.
- Union boycott of an employer's products to pressure him for recognition if it doesn't have a worker majority.
- Signing "hot cargo" contracts. Teamsters have demanded such contracts from common carriers who agree that their employees do not have to handle the goods of a trucking customer the union is trying to organize. This has the effect of pressuring the customer to recognize the Teamsters through an already-organized employer.

As far as unions are concerned, this trio of decisions really hurts. They are the first policy ruling of the five man Board under its new chairman, Boyd Leedom. Particularly they cripple the strategy of the Teamsters union, which has always been to short-cut the organizing route by going through an employer rather than his workers, wherever possible. The trucking union, by this tactic, has grown into the nation's largest with almost 1.5-million members. It has been used particularly against smaller employers. Now, disarmed of these weapons, the organizing advances, which are still going on, should simmer down.

Moves from hole-to-hole without "bull work"

the MOBILE G-800



Operated by just one man, the self-propelled CP Tracdril saves time moving from hole-to-hole, permits more accurate spotting and allows more time for productive drilling. Towing a 13,000 pound compressor as its own air supply, the Tracdril easily moves over rough terrain on crawler tracks and can be quickly positioned to run bench holes and lifters. Equipped with a hard hitting CP-400 Drifter and adaptable CP Drill Carriage and U-arm. See your CP equipment distributor for details, or write: *Chicago Pneumatic Tool Co., 6 East 44th Street, New York 17, New York.*

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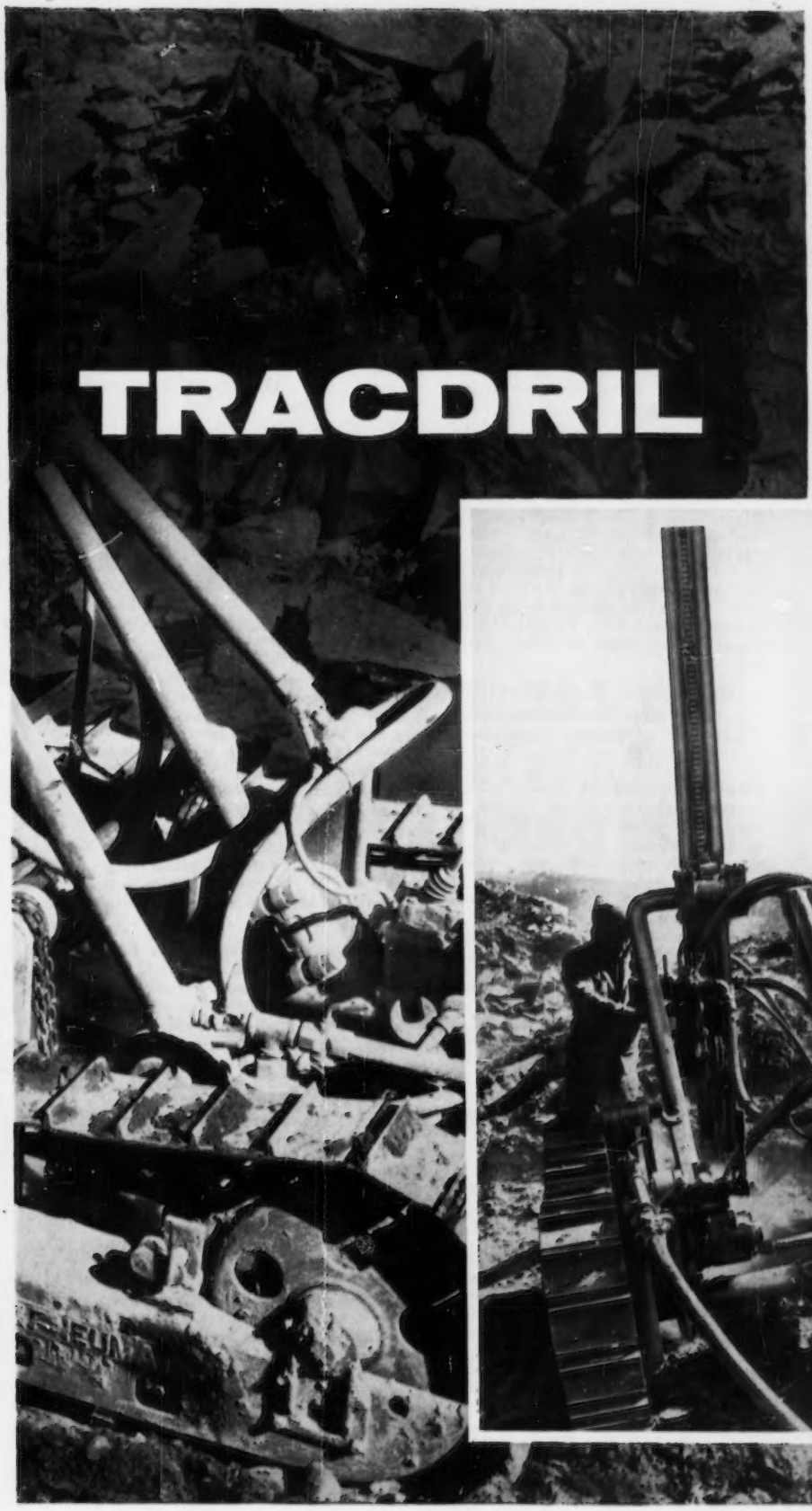

The Tracdril takes uneven ground in stride because "knee-action" tracks keep the hydraulically operated U-arm level. Reversible tramming motors enable the Tracdril to go forward, backward and pivot . . . "dead man controls" on tramming motors give instantaneous response, afford greater operating safety.

WHAT'S NEW IN U. S. PATENTS

OLIVER S. NORTH

Exploration

Gravitational surveying method and apparatus for determining presence of anomalies and unconformities in geological structure in the vicinity of an anomaly of known dimensions and density. W. W. Garvin and J. R. Leggett, assigned to California Research Corp. No. 2,801,794.

Mining

Design for a wheel-supported portable drill rig especially suitable for carrying short leg stopers for drilling upward holes in workings having low head room. J. E. Feucht, assigned to Westinghouse Air Brake Co. No. 2,802,641.

Improved rock drill bit of the off-center type capable of drilling oversized holes. Means are provided for removing cuttings promptly, thereby obtaining greater bit footage and a more efficient drilling operation. A. Feucht, assigned to Westinghouse Air Brake Co. No. 2,802,642.

Collapsible air ducts for mines consist of films of synthetic material, such as polyamide or polyvinyl resins. Liquid raw material is sprayed onto a cylindrical mandrel, solidified and stripped off. Wire rings or wire coils are inserted at intervals to provide support during use. Mine air ducts of this type are relatively inexpensive, convenient to transport, and easy to install in mines. H. G. Schauenburg. No. 2,804,095.

Metal and Mineral Processing Ore Dressing

Improved ball mill shell linings. The lining is formed with spaced projections on its inner surface which are two or more times as wide as the spaces between them. Projections from helices are directed towards outlet end of the mill. In operation, the smallest balls slide down the grooves towards the outlet end and the larger balls accumulate at the inlet end. This lining has relatively long life and requires provision of fewer compartments in the mill than previous linings, since grinding bodies varying widely in size can be used in each compartment. O. P. Frankert, assigned to F. L. Smidth & Co. No. 2,801,804.

Asbestos fiber recovery apparatus and method. A shallow bed of crushed asbestos-bearing rock is vibrated along an air-permeable deck. Air is forced upwardly through the deck, and opened bundles of fiber tend to become stratified on top of the ore bed. Suction is applied above the bed to draw off fiber, and the remainder of the material is discharged continuously from the pneumatic separation chamber. D. Weston and A. R. MacPherson. No. 2,803,346.

Mr. North is patent consultant, Washington, D. C.

Magnetic material separator for ores containing magnetic and non-magnetic fractions. Improved means is provided for supporting and guiding the material undergoing treatment. W. H. Newton, assigned to Jeffrey Mfg. Co. No. 2,804,207.

Froth flotation reagent for treating sulphide ores of copper, lead, zinc, iron, molybdenum, nickel and gold. New reagent, an aliphatic monocarboxylic acid diester, acts as a frother and can be used either alone or in conjunction with collecting, modifying, or activating agents. Resulting froth is not noticeably brittle or weeping, and need for addition of a froth-stiffening substance is obviated. D. I. H. Jacobs, assigned to Distillers Co. Ltd. No. 2,803,345.

Economic process for treating spodumene to recover lithium values directly as lithium chloride. Ore is calcined, digested with excess aqueous HCl at a temperature slightly below the boiling point of HCl for a period of at least 10 hours, and the lithium chloride separated from spent spodumene by washing. Lithium recovery exceeds 90%. L. J. Reader, assigned to Foote Mineral Co. No. 2,803,518.

COPIES OF U. S. PATENTS can be purchased at 25c each from Commissioner of Patents, Washington 25, D. C.

Processing of phosphate rock to produce monoammonium phosphate, calcium nitrate and mixed nitrogen-phosphorus fertilizers. Ground ore is calcined and treated with nitric acid, and resulting solution separated into two portions for further processing. G. G. U. W. Swensen and J. R. L. Swensen, assigned to Norsk Hydro-Elektrisk Kvaelstofaktieselskab. No. 2,803,531.

Process for separating nickel from cobalt in primary solutions of salts of sulphates and chlorides where the Ni-Co ratio is equal to or higher than 1:2. Controlled quantities of nickelous and cobaltous hydroxides are added to the solution, which is then reduced with a hydrogen gas at elevated temperature and pressure. Nickel is precipitated in the metal form, and the cobalt values remain in solution. M. De Merre, assigned to Societe Generale Metallurgique de Hoboken. No. 2,803,537.

Hydrometallurgy

Wet catalytic method of treating tungsten ores such as ferberite, wolframite and hubnerite. Ground ore is added to an alkaline solution containing about 2 to 5% by weight of sodium formate or potassium formate, and extracted under pressure and at a temperature of 100 to 108 deg C, to form a tungsten salt which is dissolved and stable in said solution. G. A. Zotos. No. 2,802,718.

Low cost process for manufacturing iron-free titanium tetrachloride directly from low-iron ilmenite concentrates or similar materials. Combination of chloridization, sublimation and condensation steps is used. Usual difficult and expensive purification process is not required. H. S. Cooper, assigned to Walter M. Weil. No. 2,802,721.

Conversion of phosphate rock to superphosphate is facilitated by addition of an organic wetting agent, such as a salt of hydrocarbon sulphuric and sulphonic acids, to the sulphuric acid before the acid is mixed with the ground phosphate rock. Curing time is reduced, and the superphosphate product has improved flowability and decreased caking tendency. L. L. Jaquier, Jr., assigned to Phillips Petroleum Co. No. 2,802,728.

Continuous process for recovering the potassium-sodium double salt, glaserite, from solid langbeinite and potash brines. A saturated aqueous slurry of langbeinite, KCl, and potassium-enriched recycled brine is heated to reaction, and the glaserite produced is filtered off and dried for use as a low-cost constituent in fertilizer. Mother liquor is further processed by conventional methods to produce other mineral values.

The flowsheet is as follows: It should be noted that NaCl is separated from the mother liquor so that it will not be returned to the reaction tank to contaminate the glaserite. Leach brine used in this separation step is prepared from langbeinite or sylvite ore or sylvite flotation tailings. When this circuit is in full operation, it will be necessary to add little if any KCl slurry to the system, since the recycled brine will contain sizable amounts of that material. W. B. Dancy and W. N. Stanley, assigned to International Minerals & Chemical Corp. No. 2,804,370.

Recovery of potash values from langbeinite and sylvite ores. High yield and high purity are obtained by treating the brine with gypsum, filtering off the solid phase syngenite produced, evaporating to precipitate NaCl, and separating and cooling the evaporated mother liquor to crystallize potassium chloride. W. B. Dancy and A. Adams, assigned to International Minerals & Chemical Corp. No. 2,804,371.

Cyclic process for treating ilmenite and other titaniferous ores, titanium slags, and the like to recover high-titania concentrates. Ground ore is extracted with aqueous HCl at a temperature between 60 and 100 deg C, and the acid solution of $FeCl_2$ and $FeCl_3$ filtered off. Small percentage of an acid-compatible surface active agent, such as alkyl sulphate, is added to the HCl to accelerate the extraction step. Two successive treatments with acid are recommended to obtain an extremely iron-free product. J. Kamlet, assigned to National Distillers & Chemical Corp. No. 2,804,375.

Method of producing a digestible titanium concentrate from titaniferous iron ore. Ground ore is mixed with fluxes, silica

J. L. BEDENBAUGH HAS CAT DIESEL POWER BECAUSE HE CAN'T AFFORD DOWN TIME

That's a good vein of fuller's earth being mined near Quincy, Fla., by the Model 85 Northwest dragline shown above. Production is a profitable 4,000 tons per month, not counting all the overburden which is removed.

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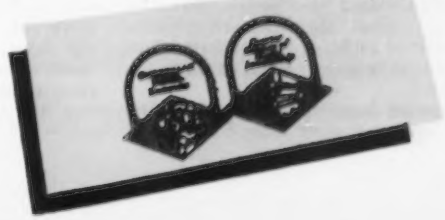


U. S. PATENTS *(Continued)*

and coke, smelted, and the slag cooled and leached with H_2SO_4. Leached slag, which is high in titanium, is digested in 89% H_2SO_4, to put most of the titanium content into solution, and it is recovered as soluble titanium sulphate. D. L. Armant and H. S. Sigurdson, assigned to National Lead Co. No. 2,804,384.

Pyrometallurgy

Improved process for utilizing materials containing iron ore fines by mixing them with a minor portion of coal, coking the mixture, and coking that product with a major portion of coal. When this two-stage coking method is used, sulphur content of the final coke is reduced and yield of commercial ammonia and tar is unaffected. This process is suitable for taconite, magnetite, or hematite ore fines, and blast furnace flue dust. J. Becker, assigned to Koppers Co., Inc. No. 2,801,913.

Improved blast or open hearth furnace charging ore is made by briquetting iron ore fines with concentrated H_2SO_4. Such bricks will sink through the slag in an open hearth furnace. When used in blast furnace, the pellets will retain shape until immediately before conversion into metallic iron. H. F. West and J. H. Veale, assigned to Illinois Clay Products Co. No. 2,806,775.

Iron ore agglomerates are rendered strong and resistant to handling breakage by coating the heated pellets with pulverized limestone or dolomite. J. H. Veale and H. F. West, assigned to Illinois Clay Products Co. No. 2,806,776.

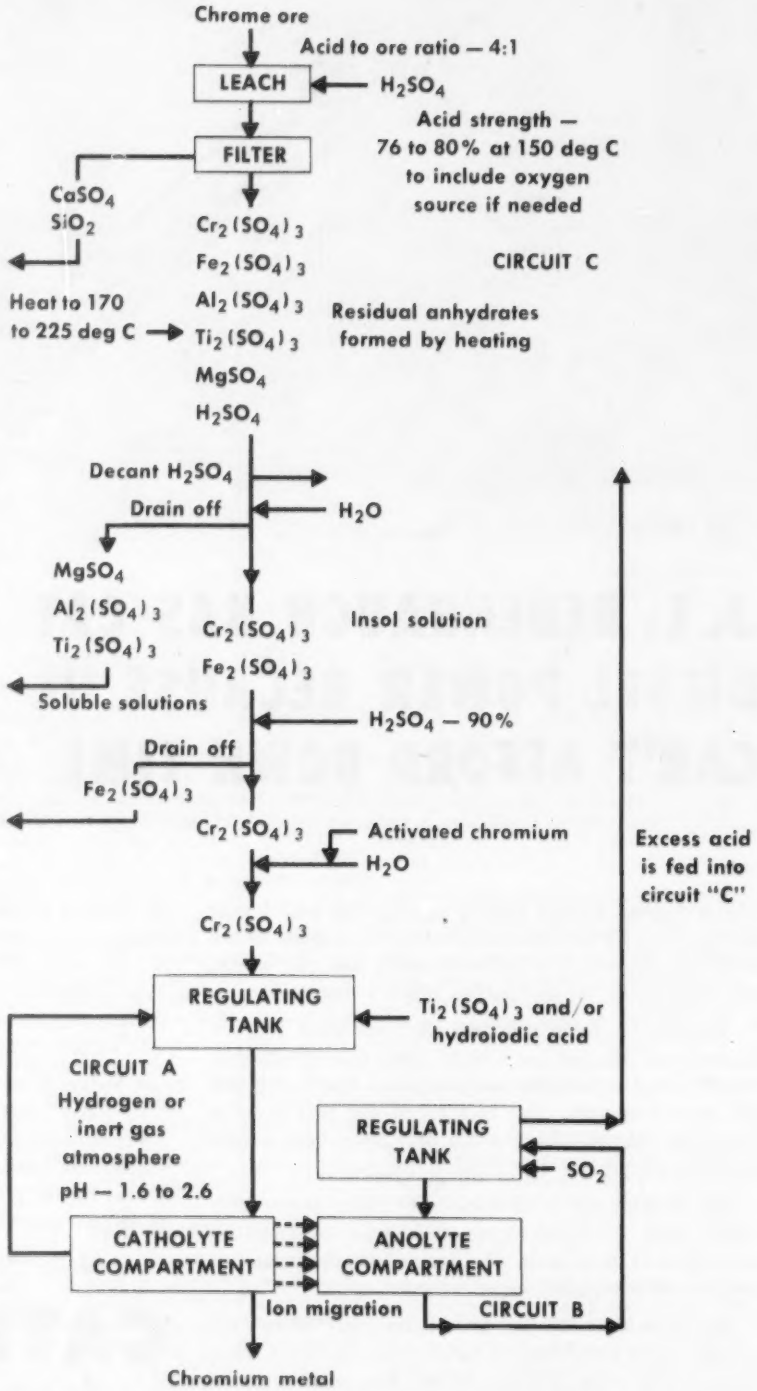
Production of crust-bearing agglomerates from hematite, magnetite, or taconite fines. Pellets are coated with a slurry of hydrated lime and fired to about 2400 deg F. Resulting agglomerates have a thick, pitted, hard crust, and can be transported and handled with minimum spalling and breakage. J. H. Veale and H. F. West, assigned to Illinois Clay Products Co. No. 2,806,777.

Method of producing iron from iron ore comprises the steps of pelletization, partial reduction and final reduction. S. L. Case, assigned to McWane Cast Iron Pipe Co. No. 2,806,779.

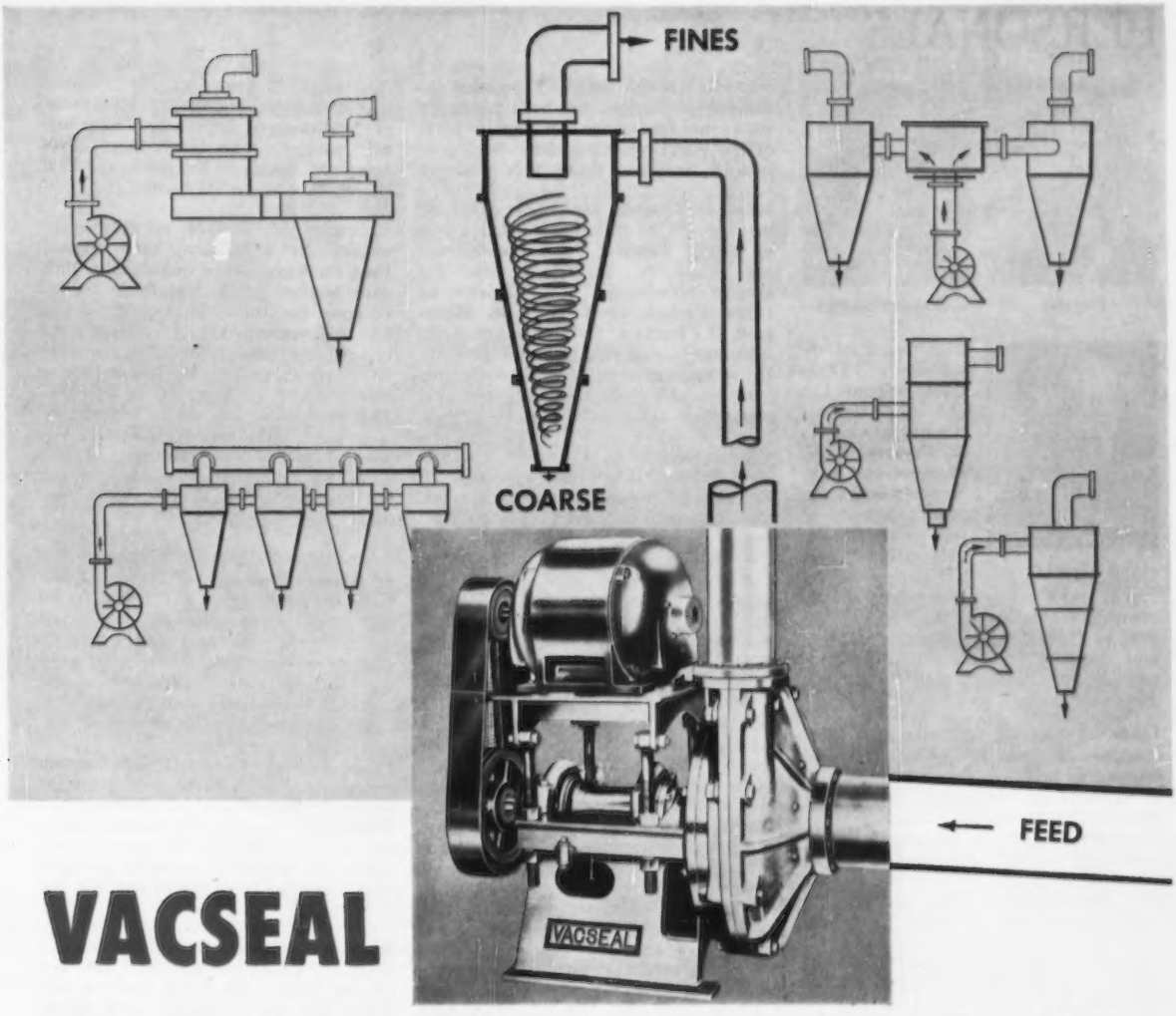
Method for extracting chromium metal from chromite sands, disseminated chromite ores, etc. Ore is leached with H_2SO_4, and siliceous materials and calcium sulphate filtered out. Solution is heated with titanous sulphate to reduce chromic sulphate to chromous sulphate, and then electrolyzed to produce metallic chromium. This method is a simple, continuous process requiring only a few low-cost reagents. Sulphuric acid is regenerated and re-used. Titanous sulphate may be obtained from the system as a by-product when the ore used contains ilmenite or rutile, or it may derive from ilmenite intentionally added to the source material.

Drawing is an essentially self-explan-

PRODUCING ELECTROLYTIC CHROMIUM



atory flowsheet of a preferred form of this invention. "A" represents the cathodic circuit, "B" pertains to the anolyte circuit of the electrolytic process, and "C" is the leaching circuit. System here depicted is particularly suitable for treating chromite-ilmenite-rutile beach sands found north of Bandon, Oregon. G. C. Westby, assigned to Key Metals Corp. No. 2,803,594.



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PERSONALS

Fogarty

VanderStucken

Meagher

The Board of directors of Texas Gulf Sulphur Co. at its October meeting elected **C. F. Fogarty, E. C. Meagher** and **E. F. VanderStucken, Jr.,** vice presidents of the company. Dr. Fogarty is manager of the geological department in the company's Houston office and is a resident of Houston. Mr. Meagher is treasurer and Mr. VanderStucken, Jr. secretary of the company, both in its New York office.

Leslie M. Cassidy, chairman and chief executive officer of Johns-Manville Corp. has retired because of ill health. Named to succeed him is **Adrain R. Fisher,** who continues as president and director. Mr. Cassidy continues as a director and consultant to the Johns-Manville management. **Clinton B. Burnett** was elected to the newly created office of executive vice president and was made a director.

Robert H. Jacobson, comptroller of Copper Range Co., and **William P. Nicholls,** vice president and director of White Pine Copper Co., subsidiary of Copper Range, have been elected vice presidents of Copper Range Co. **George R. McGrath,** plant comptroller of White Pine Copper Co., has been elected a vice president of White Pine.

Bruce D. Crawford has been appointed general manager of the Linatex Corp. of America. He was with the American Cyanamid Co. close to 30 years, doing laboratory research and field work in the Mining Chemical division, and transferring to Cyanamid Products Ltd., London in 1945 and in 1950 to their South African affiliate, South African Cyanamid Pty., Ltd. where he was general manager from 1951 through 1956.

K. Allan Belfrage, president of Atlas Copco Aktiebolag, and one of Sweden's leading businessmen, is currently visiting the U. S. as a member of a Swedish industrial mission invited here for discussions with World Bank and International Monetary Fund officials. His election on April 13, 1957 as head of the internationally active Atlas Copco Group of companies came just three years after he had left a career diplomat's post with the Swedish government to enter private industry.

Stanley Marwin, formerly assistant to the works manager, has been appointed works manager of the Los Angeles plant of the American Manganese Steel division of American Brake Shoe Co.

John L. Lamont has been appointed manager of the technical services group of Metals Research Laboratories, Niagara Falls, N. Y., which serve the Electro Metallurgical Co., division of Union Carbide Corp. **Peter M. Moanfeldt** of Charlotte, N. C., has joined the laboratory's staff as a technical assistant. He is a recent metallurgical engineering graduate of Lehigh University and is a member of American Society for Metals.

Ventures Limited's board of directors have announced the election of **J. D. Barrington** as a director, and his appointment as president and managing director. Formerly president of Polymer Corp. Ltd., Mr. Barrington remains director of that corporation. **F. V. C. Hewett** has been appointed chairman of the board and **J. S. D. Tory,** vice chairman and general counsel.

Appointed chief metallurgist of Leschen Wire Rope division, H. K. Porter Co., Inc., **Dr. Ottilie Amminger,** holder of a degree from Technical University of Vienna and a doctorate in Technical Science from the same school, has been assistant professor, teaching metallography, spectrography and radiography, and has performed research in amalgam metallurgy and exoelectrons. She was in charge of the chemical laboratory at the metallurgical department of L. von Roll Eisenwerke A. G. in Switzerland.

Dr. L. I. Dana, up to now vice president-research of Linde Co., division of Union Carbide Corp., has been appointed vice president-research and development. **David Swan,** formerly director of research of Metals Research Laboratories serving Electro Metallurgical Co., another division of Union Carbide, has been appointed director of research of Linde Co.

Harry J. Wolf, mining and consulting engineer of One Park Place, New York 7, N. Y., has just returned from examining uranium deposits in Utah and Arizona.

V. F. Daughney, formerly with Heath Steele Mines, N. B., Can., as mill superintendent and metallurgist for 2½ years, has now joined the concentrates staff of Erie Mining Co., as assistant general foreman.

R. E. Shreve, formerly assistant mill superintendent at the Shiprock, N. M. uranium processing mill of Kerr-McGee Oil Industries, Inc., has been appointed mill superintendent.

Dr. J. R. Gump, until recently with Heavy Minerals Co. as senior research chemist, has joined Michigan Chemical Corp., St. Louis, Mich. as group leader in charge of inorganic research.

Appointed chairmen of the chemical engineering and metallurgy departments of Northwestern University Technological Institute, respectively, were: **Prof. Joseph M. Smith,** of Evanston, and **Prof. Morris E. Fine,** of Wilmette, Ill.

Recipients of two of AIME's major awards for 1958 have been selected: **Fred De Vaney,** chief metallurgist, Pickands Mather & Co., Duluth, Minn. will be given the Robert H. Richards Award for achievement that "furthers the art of minerals beneficiation." The Benjamin F. Fairless Award, "in recognition of distinguished achievement in iron and steel production and ferrous metallurgy," will go to **Hjalmar W. Johnson,** vice president-steel manufacturing, Inland Steel Co., Chicago. Presentations will be at AIME's annual banquet in New York, Feb. 20, 1958.

Cleveland-Cliffs Iron Co. announced that **H. Stuart Harrison** and **Jeptha Homer** have been elected to the board to fill the vacancies caused by the very recent deaths of **Morgan B. Brainard** and **G. Garretson Wade.** Mr. Harrison is presently vice president-finance and is also a director of Jones & Laughlin Steel Corp. and Medusa Portland Cement Co.

Dr. S. E. Malouf has left Chibougamau to assume his duties as vice president and general manager of Chibougamau Mining and Smelting, in Toronto, where Dr. and Mrs. Malouf will establish residence. Dr. Malouf is consulting geologist for Campbell Chibougamau and also for Yorcan.

Norman Whitmore, owner of Minerals Engineering Co., Los Angeles, Calif., has left for Turkey via South America and Africa, and will return via India, where he will examine manganese and chrome.

Key promotions of three veteran members of the Battelle Memorial Institute staff were announced recently: **Bertrand A. Landry,** technologist in the field of combustion and energy, and **Dr. Richard J. Lund,** geologist and mineral economist, were named assistant technical directors. Both will take on broadened responsibilities in the over-all guidance and technical direction of Battelle's research. **David D. Moore** was named manager of Battelle's economics department. He is particularly known for his studies on fuels and energy, including participation in one of the problems of preparing fuel gas from coal.

Richard M. Foose, formerly chairman of the Geology department of Franklin and Marshall College, Lancaster, Pa., has been appointed to head newly formed Earth Sciences Department of Stanford Research Institute's Physical Sciences division, Menlo Park, Calif.

Lyman C. Huff, formerly with USGS in Denver, is now associated with the Military Geology Branch, U. S. Geological Survey, Washington, D. C.

Get cost-tumbling 4-machine utility in NEW mining TD-6 4-in-1

U. S. Bureau of Mines APPROVAL No. 2410

The components of this new International Drott underground mining tractor were safety-tested and approved at the Bureau of Mines Laboratory, Pittsburgh, Pa.

Yes, now you can have the exclusive 4-In-1 with four-machine utility in another New International Drott mining tractor: the new TD-6 with one cu. yd. capacity.

The versatile, big-capacity TD-6 meets rigid U. S. Bureau of Mines safety standards for non-coal mining. It features the new short-coupled, stainless steel scrubber—that cools exhaust to a maximum of 160°F, while efficiently dissolving irritating aldehydes with water-bath turbulence.

The new design also provides blower fan action on the final exhaust which breaks up noxious gas concentrations to a ratio of 40 parts fresh air to one part exhaust.

In addition, low, 5-foot "trolley-clearing" profile, and "lean-over" features of the compact new TD-6 provide unmatched, full-load "mine-tunnel" maneuverability.

Prove the tremendous cost-cutting, profit-producing advantages by getting big-capacity four-machine utility for one moderate investment—instantly, at the touch of a hydraulic machine-selector lever! See your International Drott Distributor for a demonstration of the new TD-6—or 1½ cu. yd. TD-9—mining tractor!

International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 15, Wisconsin

INTERNATIONAL DROTT

Ever wish you could pull a dozer "out of your hard-hat"...

to quickly shove material aside or do it? Well, it's just that simple with the International Drott 4-in-1!

Ever wish you could have a clamshell by "a twist of the wrist"...

to have a bucket with "stand-and-dig" action to work under low ceilings and in close quarters? Well, it only takes a flip of the lever to start earning money with the 4-in-1's clamshell!

Ever wish you could take a "carry-type scraper" underground...

one that can strip, grade, or spread with inch-close accuracy—and can "skin-off" layered materials like nothing else on tracks? Well, you can! Famous 4-in-1 gives you this option, too!

Ever dream you could command "rock-busting" Skid-Shovel action...

and a mobile, sure-treading crawler loader—and get three other machine actions, to boot? Well, you can in a 4-in-1—for Skid-Shovel action, with exclusive pry-action break-out, is integral in 4-in-1 design!

PERSONALS (*Continued*)

Allen H. Engelhardt, who has been operations manager of Cerro de Pasco Corp.'s nonferrous mining, smelting and refining operations in Peru and heretofore headquartered at La Oroya, has been appointed recently to the new post of vice president, South American operations, with offices in N. Y. Mr. Engelhardt became associated with Cerro de Pasco in January 1951, as assistant manager of operations in Peru and was made operations manager later the same year. Prior to that he worked for South American Development Co. in Ecuador as a consulting engineer at Cotopaxi, a gold and copper property, as resident manager at Calera, another gold property, and later at Portovelo, Ecuador, where he was resident manager and vice president.

Engelhardt

Appointment of **Stanley W. McDougall,** formerly manager of mines, to the newly created post of manager of Bunker Hill Co.'s Kellogg operations became effective Oct. 1. McDougall joined Bunker Hill on a full-time basis in 1924 after graduation from the University of Idaho with a mining engineering degree.

Mine superintendent **Joseph E. Gordon** has been advanced to the mine manager post, and **Edward B. Olds,** assistant mine superintendent, succeeds Gordon.

President-elect of the Institution of Mining and Metallurgy (London) for 1958-1959, is **J. B. Dennison,** who joined the Institution as a student in 1919. His professional career began in 1921 at Santa Gertrudis Co., Ltd., in Mexico; from 1924-1934 he was with Rio Tinto Co., Ltd., in Spain; in 1934 with Halkyn District United Mines, Ltd., North Wales, and during 1935 he was inspector of mines in Argentina, Czechoslovakia and Australia. From 1936-1945 he was advisory engineer to Anglo-French Exploration Co., Ltd. in Johannesburg, and in 1946 consulting engineer to African Exploration Co., Ltd., also in Johannesburg. In 1947 he became consulting engineer in London for Johannesburg Consolidated Investment Co.

Dr. Serge A. Berkovich has been appointed director of research for the newly formed division of Technical Service Laboratories, Toronto. Since 1951, he has been associated with Sherritt Gordon Mines and more recently was research supervisor for Deloro Smelting & Refining Co.

Appointment of **George L. Mill** as vice president of Nickel Rim Mines Ltd. was announced recently. Associated for the past 25 years with the former South American Mines Co. Ltd. which operated properties in Ecuador, S. A., with headquarters in N. Y., Mr. Mills returned to Canada in 1950 as vice president of that company's Canadian interests. For the past several years he has also served as consulting metallurgist to Cerro de Pasco Corp. in N. Y.

James W. Clark, of Marquette, Mich., has been promoted to manager of the mining machinery division of Lake Shore, Inc. Mr. Clark has been instrumental in the development of Lake Shore's "Jeto" bottom-dump skip, the new roll-over car and other mining machinery. Jim Clark is also mayor of the city of Marquette.

Philip W. Simmons, USBM, Grand Junction, uranium advisor, has accepted a two-year assignment as counsel and advisor to the Indonesian Bureau of Mines. He will be the first metal mining engineer supplied by the U. S. Bureau of Mines, which has been commissioned by the International Cooperation Administration to supply mining technical aid to certain foreign governments. Mr. Simmons' schedule will bring him to Djakarta Nov. 27, with his family to follow shortly thereafter. His address will be: Mining Engineer—U. S. Bureau of Mines, United States Operations Mission, Djakarta, Indonesia, Department of State, Washington 25, D. C.

Simmons

Joseph C. Abeles, a director, vice president and treasurer of Kawecki Chemical Co. of Boyertown, Pa., has been elected a director of Haile Mines, Inc.

Thomas T. Fleming, Jr. has been elected a director, vice president and general manager of Frank Samuel & Co., Inc., a wholly-owned subsidiary of Haile Mines, Inc.

Ivor G. Pickering and **John D. McIver** have been selected project manager and project engineer, respectively, for Kennecott Copper Corp.'s new $20-million electrolytic refinery, to be built near Baltimore, Md. Pickering has been chief design engineer for Western Mining division's engineering department, and McIver has been tank house general foreman at the company's Utah Copper division electrolytic refinery at Garfield, Utah.

Roscoe H. Channing, president and a director of Hudson Bay Mining & Smelting Co., Ltd., has retired, according to announcement made October 31. **C. V. Whitney,** chairman of the board, has been elected president. **Harry P. Whitney** was elected a director succeeding Mr. Channing. Mr. Channing has been a board member since the company's organization in 1927 and president since January 1931. C. V. Whitney is the son and Harry P. Whitney, the grandson of the late Harry Payne Whitney, founder of the company.

Erskine R. E. Carter, Toronto lawyer, has joined Patino of Canada Ltd. as managing director and has been elected president of Copper Rand Chibougamau mines.

Canadian Dyno Mines Ltd. recently elected **Hon. Charles P. McTague,** Q.C., LL.D., **Leonard P. Chalmers, George C. Knowles** and **Harlow H. Wright,** P.Eng., as directors of the company.

George E. Kruger has been appointed to the official staff of the Chase Manhattan Bank as mining geologist. He was formerly associated with Cerro de Pasco Corp. and Ventures Ltd. and has been a consultant in mining geology in South America and New York.

Kenneth W. Bruland, who has been associated with the Alan Wood Steel Co. for the past 21 years and during the past six years actively engaged in research on the development of iron powder production methods and processes, has been appointed superintendent of the company's new iron powder plant to be constructed at Ivy Rock, Pa.

C. D. Howe has been elected to the board of directors of Atlas Steels Ltd. Mr. Howe was formerly Minister of Trade and Commerce for Canada.

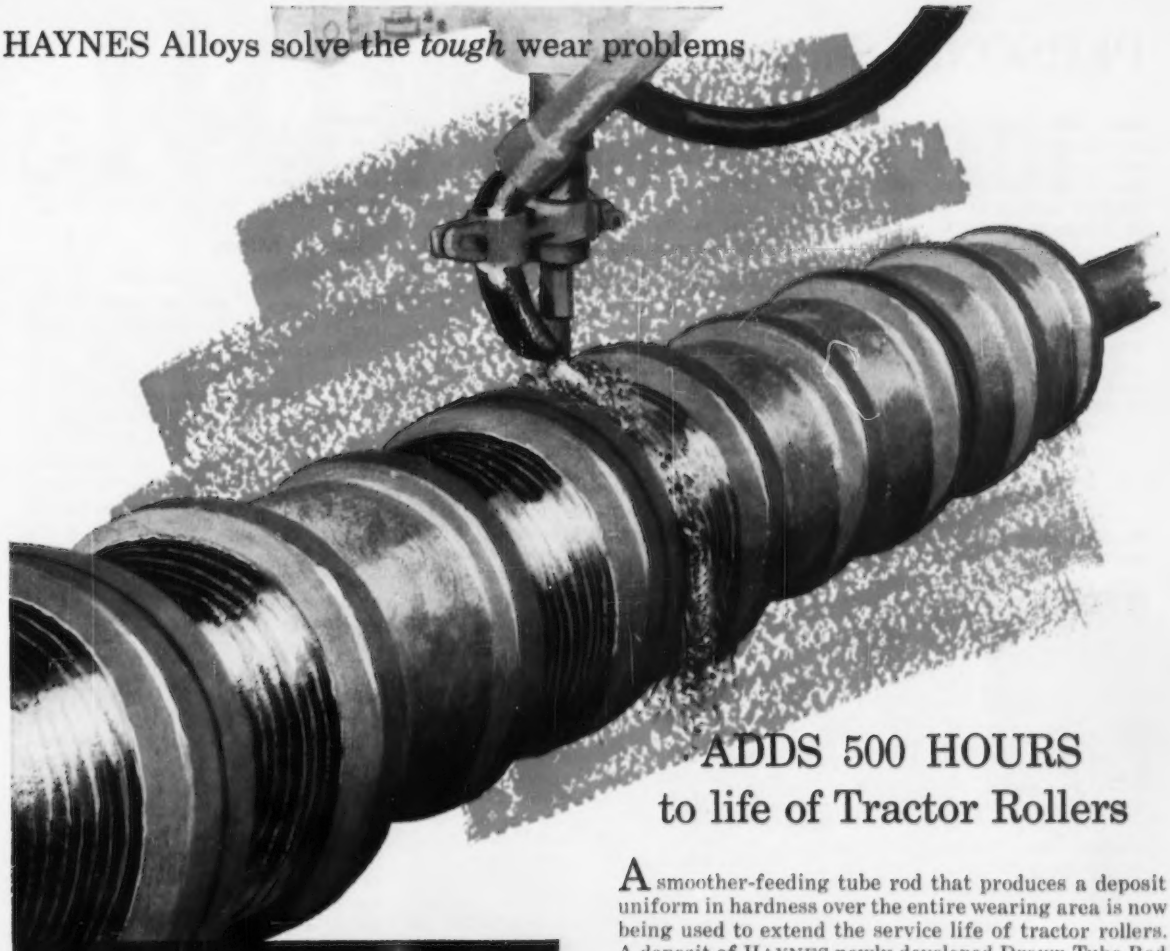
Gerald FitzGerald, chief topographic engineer of the U. S. Geological Survey, since 1947, has retired. He has served continuously since 1917 except for brief intermissions to resume studies in engineering, until 1942; working on surveying and mapping assignments in U. S., West Indies and Alaska. He became a specialist on reconnaissance mapping and received the 1944 Award of American Society of Photogrammetry for "outstanding achievement in photogrammetry."

R. C. Bacon, formerly vice president of Ventures, Ltd., has joined the staff of C. F. Braun & Co., Engineers, of Alhambra, Calif. He is located in the company's New York office.

John A. Cooper, former design engineer for Kennecott Copper Corp.'s Western Mining Divisions, has been named project engineer for the mill expansion, including the L-P-F (Leach-Precipitation-Flotation) at the Hayden plant of Kennecott's Ray Mines Division.

W. A. Hutchison has been appointed general manager of Phelps Dodge Corp. of Canada, Ltd., the newly-formed Canadian exploration subsidiary of Phelps Dodge Corp. of N. Y. Prior to his affili-

HAYNES Alloys solve the *tough* wear problems

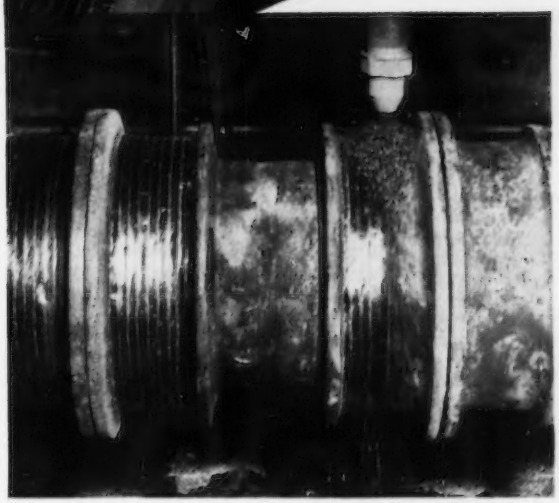


ADDS 500 HOURS to life of Tractor Rollers

A smoother-feeding tube rod that produces a deposit uniform in hardness over the entire wearing area is now being used to extend the service life of tractor rollers. A deposit of HAYNES newly developed Drawn Tube Rod in Coils gives the rollers an expected service life of 2500 hours—or uninterrupted operation for 1½ years! This is a life span 20 per cent longer than that of new unprotected rollers . . . and the worn areas can be hard-faced at about ½ the cost of a new roller shell.

There are 6 alloy compositions available in the new drawn tube form—varying from very tough and shock resistant to very hard and abrasion resistant. Write for full details on prices, compositions, and recommended uses.

HAYNES STELLITE COMPANY, Division of Union Carbide Corporation, Kokomo, Indiana. Sales offices in Chicago — Cleveland — Detroit — Houston — Los Angeles—New York and San Francisco.



HAYNES drawn tube rod in coils can be used with standard equipment without nozzle change . . . meet standard wire tolerances . . . withstand the same feed roll pressures as solid wire . . . and assure steadier deposition.

See... or *Write...*

Your local Haynes Stellite Dealer

to Haynes Stellite Company

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PERSONALS (*Continued*)

ation with Phelps Dodge, Mr. Hutchison was managing director of both Northspan Uranium Mines Ltd. and Preston East Dome Mines Ltd. Phelps Dodge Corp. of Canada will have its offices at 55 Yonge St., Toronto.

Harold Howling recently joined the staff of Arthur D. Little, Inc. to work on research and development in the process metallurgy department. He was formerly with the Hudson Bay Mining & Smelting Co. at Flin Flon, Manitoba, and prior to that, with the Science Service of the Canadian Federal Department of Agriculture.

OBITUARIES

Dr. Paul Dyer Merica, 68, president of the International Nickel Co. of Canada, Ltd., and its U. S. subsidiary, International Nickel Co., from May 1952 to April 1954, died Oct. 20 at Phelps Memorial Hospital in Tarrytown, N. Y. following a heart attack at his home in Millwood, N. Y. Dr. Merica continued to serve both companies on important projects and as consultants to the officers. He was best known, both in this country and abroad, for his contributions to theoretical metallurgy.

Merica

Erle V. Daveler, 71, mining engineer and corporation executive, died Nov. 11, in his home in N. Y., after a brief illness. At his death he was a vice president and a director of the American Zinc, Lead & Smelting Co. and board chairman of the Mesabi Iron Co. He was chairman and a director of the Lone Star Cement Corp., and a director of Granite City Steel Co., Texas Gulf Sulphur Co. and the Guardian Life Insurance Co. He had also served as a vice president of AIME and as treasurer of the American Zinc Institute and was a past president of the Mining and Metallurgical Society of America.

Leroy Salsich, former president of Oliver Iron Mining Co., died in a Duluth hospital Oct. 26. Born in 1879 at Hartland, Wis., Mr. Salsich lived in Duluth and on the iron range for 56 years. He joined Oliver in 1901 as a mining engineer, and directed Oliver's operations from 1930 to 1946, the date of his retirement. He served as a vice president and director of AIME and in 1947 was awarded the Institute's William Lawrence Saunders gold medal.

Frederick MacCoy, member AIME, died at his home in Berkeley, Calif. on Oct. 14, at the age of 81. Mr. McCoy was graduated as a civil engineer from Purdue University in 1897 and later took a degree in mining from Columbia University. Between 1907 and 1929 he was with the Esperanza Mining Co. at El Oro and as manager of San Rafael Mining Co. in Pachuca, Mex. From 1934 to 1939 he managed mines in the Philippine Is. and from 1942 to 1945 he was with the Reconstruction Finance Corp. in strategic mineral development in the U. S. and abroad.

Arthur M. AuBuchon, 66, retired employee of St. Joseph Lead Co., died Sept. 29 in St. Joseph Hill Infirmary, Eureka, Mo., after a long illness.

Lawson H. Linde, co-owner of the Wingate Manganese mine in Death Valley, the Morning Star mine in Upper Owens Valley, the Big Silver mine in Saline Valley, the Panamud bentonite deposit in Panamint Valley, and the La Sal Creek uranium property at Four Corners, died in an airplane crash Oct. 19.

Thomas Robins, 89, founder and former chairman of Hewitt-Robins, Inc., and inventor of the heavy-duty belt conveyor, died in a hospital Nov. 4, after an illness of several months.

Dr. Charles Henry Snow, dean emeritus of the College of Engineering at New York University, died Oct. 28 after a long illness, at the age of 94. Dr. Snow received his Ph. D. from University of Pittsburgh and spent some years as a mining engineer before entering the teaching profession. Dr. Snow was also a founder of the American Society of Mining and Metallurgical Engineers.

Frank D. Shepherd, 50, executive vice president of Mid-West Metal Mining Association, died of a heart attack in St. Boniface hospital, Winnipeg, the last week of August.

Thomas Albert Gass, 69, president of Sand River Gold Mining Co., died the week of Oct. 10 in Toronto. He was also a director of Goldyke Mines and of God's Lake Gold Mines, wholly-owned subsidiary of R. J. Jowsey Mining Co.

Ben H. Miles, 62, well known mining man in the Coeur d'Alene district, passed away in Spokane the early part of October. In recent years he had been associated with Sierra Silver-Lead Co.

Percy B. Butler, 81, retired mining engineer and consultant, died July 30 in Los Angeles, after a short illness. Mr. Butler had been engaged in mining in Mexico and Joplin for many years and was also active in Tri-State operations. He was a member of AIME, the Mining & Metallurgical Society and a member of the board of directors of Mining Association of California.

Charles Joseph Gray, 83, former chief inspector of mines for the Union of South Africa, died in early September, in Johannesburg.

Donald N. Matheson, general manager and director of Bralorne mines, in the Bridge River Valley, B. C., died Nov. 7 in the Vancouver General Hospital after a long illness. He was 52 years of age.

Gunnar Mines

Continued from p101

11,000 tons of ore per week. Euclid trucks with 14.8 cubic yd heated dump boxes, dump the ore into the 42-in. Symons primary gyratory crusher which reduces the material to minus 5 inches. Crushed ore is conveyed to a 1,000 ton surge bin which is also in closed circuit with the secondary and tertiary crushers. From the surge bin, the material is fed at a rate of 560 tph to two Symons 5 x 8 rod deck screens set at 1½-in. Oversize (175 tph) is conveyed to a 5½-ft Symons standard cone crusher for reduction to minus 1¼-in. size, while the undersize (385 tph) is fed to a pair of Symons 4 x 8 ft rod deck screens with ⅝-in. openings. Oversize from these later screens (165 tph) is conveyed to a 5½-ft Symons short head cone crusher set at minus ½-in. and the minus ⅝-in. ore from the screens is conveyed to storage bins. Material from both cone crushers is carried back to the surge bin for recycle. The circuit also includes a 100-ton fines bin for collecting fine crushed waste which is used in surfacing the roads in the area.

Gunnar's mill has two identical sections, each with a capacity of 850 tpd.

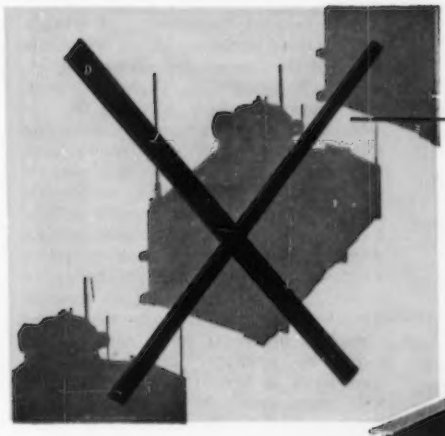
Material goes through two grinding stages in a rod and ball mill, respectively and is thickened to 57% solids prior to leaching. Sulphuric acid is introduced into the primary agitator and sodium chlorate into the secondary agitator. The uranium is then recovered from the solution by the ion exchange process, followed by precipitation with magnesia.

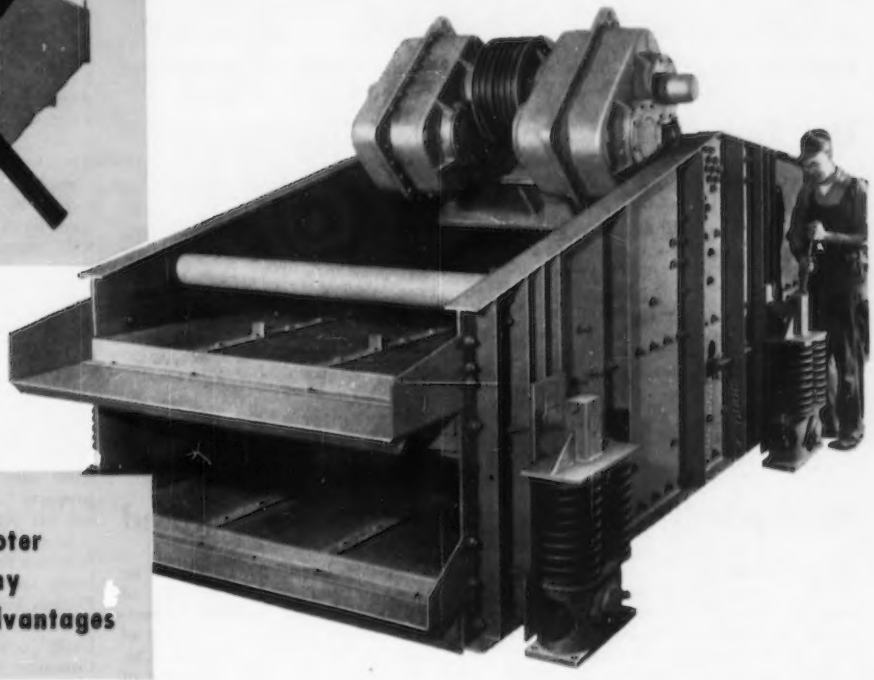
After filtering, washing and drying, the yellow powdered uranium oxide is packed in steel drums for air shipment. A 5600 ft airstrip was hacked out of the bush and a company owned plane maintains a regular schedule between Edmonton and the Gunnar airstrip.

The Gunnar uranium deposit now has an estimated value in excess of $130-million. The planned facilities were completed in little more than three years from the date of discovery at a cost of $20-million, the original estimate.

E&MJ wishes to thank J. N. Botsford, mine manager, for his assistance in the preparation of this article.

NOW one BIG SCREEN does the work of multiple units





Husky 20-footer offers many profit-building advantages

Volume — This single, high tonnage *Low-Head* vibrating screen is a unit that out-produces a series of two or more screens in coal, metal mining and rock products fields.

Multiple operations on one screen — Operations in sequence, such as draining, washing and dewatering, are accomplished on one big Allis-Chalmers screen.

Cut Cost... Save Space

Obviously, in the application of a single unit, installation cost is considerably less than that of multiple units. Feeding arrangements are simpler. Collecting hoppers and chutes are easier to install. Maintenance costs are proportionately lower. And, of course, a single big unit takes up less space than a multiple unit installation.

For complete information, see your Allis-Chalmers representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin. Ask for Bulletin 07M7500-111.

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ALLIS-CHALMERS

A-5485

THIS MONTH IN MINING *(Continued)*

$30-MILLION FACILITY includes new refinery (foreground) and open pit mine.

U.S. Borax Dedicates Its New Refinery

UNITED STATES BORAX CHEMICAL CORP. last month dedicated its new $30-million open pit mine and refinery at Boron, Calif., 130 miles northeast of Los Angeles. Undersecretary of Interior Hatfield Chilson set off a dynamite blast in the 175-foot-cavity to symbolize the first use of open-pit mining for borax.

New refinery adds 30 percent to U. S. Borax's production capacity, which was about 600 tons of boron trioxide a day. Company's former main refinery, at Wilmington, Calif., has been converted exclusively to production of boric acid and specialties.

The Boron location contains the world's largest known deposit of sodium borate, representing more than 70% of the Free World's known boron supply. Replacement of room-and-pillar methods with open pit will assure virtual 100% recovery of the ore. Mined at current rates—about 800,000 tons a year—the deposit would last "not less than" 100 years, according to U. S. Borax president James M. Gerstley.

Stockpile Review Board Members Appointed

ODM'S Gordon Gray has announced 11 of the 12-man membership of ODM's Stockpile Review Advisory Committee. It will be headed by Holman D. Pettibone, board chairman of Chicago Title & Trust Co. Arthur Wolf of the ODM staff will be the group's executive officer. A first, purely organizational meeting has been held.

Gray plans to appoint an additional industry member to the group. The 10 members, besides Pettibone, include Dr. John Morgan (White House minerals adviser and former ODM-er), Henry Fowler (former ODM director), Dr. Clyde Williams (president of Battelle Memorial Institute).

It is apparent from the committee composition that Gray intends it to be representative of the national interest. The intent is probably that the committee make recommendations of stockpile policy with the notion the policy reflects the fiscal and strategic needs of the country rather than the economic situation of the industries directly involved in stockpiling.

Other members are:

Dr. Earl L. Butz, dean of the School of Agriculture, Purdue University, and former Assistant Secretary of Agriculture; Donald F. Carpenter, general manager, Film Department, E. I. DuPont de Nemours Co., and former chairman of the Munitions Board, Defense Department; Dr. Edwin L. Crosby, director of the American Hospital Association, Chicago, Ill.; Henry H. Fowler, member of the Washington, D.C. law firm of Fowler, Leva, Hawes and Symington, and former director of the Office of Defense Mobilization; Dr. John D. Morgan Jr., minerals consultant in Washington, D.C., and former member of the staff of the National Security Resources Board and the Office of Defense Mobilization; Adm. Arthur W. Radford, former Chairman of the Joint Chiefs of Staff, Defense Department; Gen. Walter Bedell Smith, vice chairman of the board, American Machine & Foundry Co., and former Undersecretary of State; James E. Webb, president, Republic Supply Co., Oklahoma City, and former director of the Bureau of the Budget and former Undersecretary of State; Dr. Walter G. Whitman, head of the Department of Chemical Engineering, Massachusetts Institute of Technology and former chairman of the Research and Development Board, Defense Department; and Dr. Clyde Williams, president of the Battelle Memorial Institute, Columbus, Ohio, and former chairman of the World War II Metallurgy Committee of the National Academy of Sciences.

Johnson *(Continued from p 79)*

or more" in this discussion of concentrates.

Using the ore tonnage figure with 5 lb of U_3O_8 per ton and 90% recovery, 18,000-plus tons of concentrates are now being produced. Questioning of officials at the Grand Junction, Colo., operations office of the Commission elicited the following "thinking": 1. There are some mill contracts which will not be renewed; 2. the Commision is considering offering contracts up for renewal and extension at same totals but over a longer period of time, i.e. a "stretch out"; 3. there are some mills which, looking toward the 1962-66 procurement program of concentrates, will be asked to slow down ore runs immediately in return for an extended contract through 1962-66; 4. there is hope that some Canadian shipments which run to 1966 might be profitably diverted by the Canadians to Britain. This would provide more room in the "budget" for purchase of U. S.-produced concentrates.

The spokesmen for the Commission make a point of the fact that there are at least two big mills in the Ambrosia Lake district of New Mexico which already are exceeding production of 500 tons annually of concentrates from "any one property."

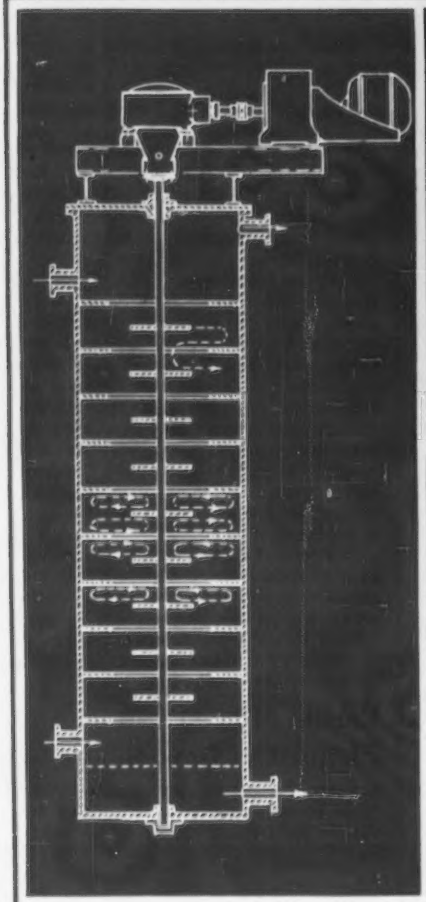
The AEC in its 1962-66 program has pledged itself to buy a maximum of "500 tons of uranium from any one property." However, the Commission has not yet defined the term "property."

In discussions with the Commission, it becomes apparent that a critical eye is being cast at certain central Colorado Plateau mills as well as the continuation of milling at the AEC-owned Monticello, Utah, concentrator operated for the Commission by National Lead Co.

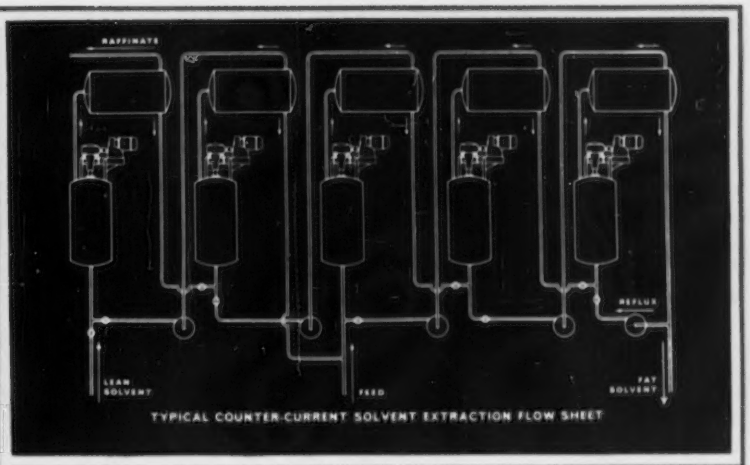
The forecast also is that the stipulation which the AEC has placed in all but two contracts for guarantee for custom milling space will come more and more into play.

Generally, the provision states that no more than 5% of the custom capacity of a given mill can be alloted one custom shipper at the expense of another. Uranium men say that generally, this custom provision will permit the small miner, or "family-sized" company, to continue and even engage in limited exploration and development. It will hardly meet the demands of heavy exploration drilling and mining machinery investment needed for ore bodies over 100,000 tons, however.

Significantly, one major firm in the Gas Hills district already has reportedly stopped all exploration and development of open pit properties. The reason: enough ore has been developed and virtually readied for mining than existing mills can now grind up before March 31, 1962.



TURBO-MIXER R.D.C. COLUMN
Licensed Under
Shell Development Company Patent



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call on TURBO-MIXER for SOLVENT EXTRACTION

Whether you are extracting uranium with mixer settlers (like Kerr-McGee and Vitro) or butadiene (like Esso Standard or Polymer Corporation) or a continuous counter-current extraction column (like Bakelite), there's a Turbo-Mixer designed exactly to meet your needs.

Turbo-Mixers are designed for maximum service, based on over 40 years of experience and specialization in mixer construction. For descriptive information showing how your problems may be solved by Turbo-Mixer, write today.

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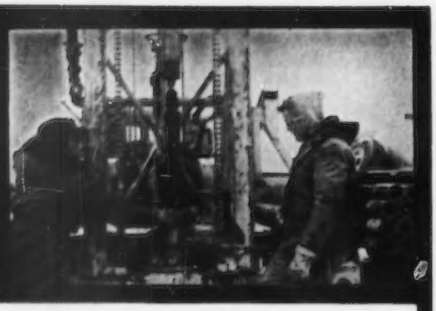
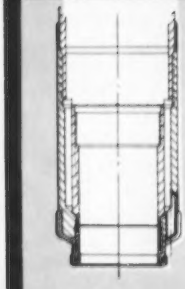
Cooperation between manufacturer and operator gives . . .



96.7% CORE RECOVERY

IN POORLY CONSOLIDATED FORMATIONS

Equipment Engineered for the Job



Core recovery in the Gas Hills of Southwestern Wyoming was only 40 to 60 percent, proving a major problem to drillers. This very low return was first attributed to the failure of core catching devices to hold core in the inner tube. After considerable trial and error with every type of core catching equipment the Christensen engineer became convinced that the circulation fluid was actually washing away the friable and poorly consolidated uranium bearing sediments before they entered the inner tube.

With all the facts and actual job experience, Christensen then adapted the 4½" x 3" core barrel for use with a long nose or pilot type diamond set core bit. This allowed the driller to actually core *ahead* of circulation.

The new barrel and bit design by Christensen, together with proper fluid and volume controls, gave impressive results.

1. Total coring has yielded 96.7% recovery.
2. *All* units of the formation have been cored successfully.
3. An average of 25 feet of core is obtained per drill shift.
4. Combined cost of diamond bit and core barrel, $2.31 per foot, considerably lower than previous averages.

Discuss your coring problems with the Christensen engineer. There is almost always an existing design for any situation, if not, Christensen can adapt one for your needs.

Do you have our catalog? Write for SD-506.

CHRISTENSEN DIAMOND PRODUCTS

1937 SOUTH 2nd WEST SALT LAKE CITY, UTAH

Johnson *(Continued)*

There continues a divergence of viewpoints in the west on Mr. Johnson's announcement. The man on the street, the holder of penny uranium stocks, etc., is dismayed at the clear revelation of fact that there is too much uranium available for current needs and the slowly developing requirements of civilian nuclear power. Uranium stocks, which weakened anyway in past months, dropped further in Salt Lake City.

For the professional, the diversion was more interesting—particularly among those who it is alleged do not realize the real import of Mr. Johnson's announcement. Those with existing mills are inclined to applaud the cutback as they realize that the U. S. expenditures for uranium concentrates purchasing in next five years will be immense and possibly subject to unfriendly Congressional review. For those in the industry seeking to get in under the deadline, it is a horse of an entirely different color.

It is with this in mind that the necessities of some over-all review of existing contracts due to expire, and of contracts which exceed 500 tons yearly in production of concentrates, seem uppermost in minds of Commission employees.

Perlite Mine, Plant Planned in New Mexico

NO AGUA, a perlite deposit in northern New Mexico, is now being mined by the Perlite Department of Great Lakes Carbon Corp.'s Mining and Mineral Products Division as the first step in what is claimed as an extensive expansion program.

To exploit No Agua, called by Great Lakes "the world's largest known deposit of uniform commercial-grade perlite," a new crushing and sizing plant is being erected at the site and, when completed, will be the perlite industry's most complete and modern processing plant for the raw material, according to D. L. Marlett, vice president and general manager, Mining and Mineral Products Division, who also said No Agua will show a production rate and require lower furnace temperatures than the ore mined at company's Rosita, Colo. deposit.

Yuba Consolidated Will Re-Enter Mining Field

YUBA CONSOLIDATED Industries, Inc. will once again enter the mining industry on a major scale. This was made clear by Yuba president, J. L. McGara when he recently announced that his firm had established a new mining division which would include the Yuba Consolidated Gold Fields and Portugese-American Tin operations, handle the engineering, manufacture, and sales of mining equipment, and maintain a newly established exploration department.

The mining division will actively search for deposits of strategic and heavy metals as well as expand its present holdings of gold and tin.

50% FASTER WITH AIR POWER

Half Century of Dependable Service

NOW.. the 'Canton' Air-Power Car Transfer

LOADS AN ENTIRE TRAIN ON A SINGLE TRACK . . . FAST!

Also self-liquidating: Track Cleaners, Rock Dusters, Electric Switch Throws, Automatic Mine Doors, Cable Splicers and Vulcanizers. See our 2-color full page ad in Coal Age Guide Book.

Now—one man does the work of three.

Cars shuttled transversely back and forth to clear track while loading empties. "Canton" Car Transfer quickly re-installed to new track location a trip length out-by loader . . . no alteration of track . . . eliminates expensive slabbing for double tracks or for California switch. No more hazards of cherry picker. Motorman *pulls* empties in, *pulls* loads out. The "Canton" Car Transfer loading cycle is fastest for most profit. Write for quotations *new* units, and *converting* your present units to Air Power.

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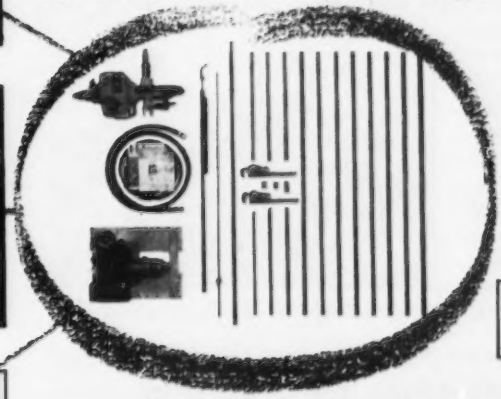
A TRULY PORTABLE DIAMOND CORE DRILL

The SUPER PIONEER

Here's a rugged, compact, lightweight drill you can take anywhere. The Super Pioneer eliminates guesswork by giving a true core sample to depths of 100 feet or more. Drills at any angle in all types of formations. Designed for one-man operation.



The complete outfit as shown being transported in pictures at left, with rods for drilling to a depth of 50', weighs just 159 lbs. Additional 5' rods weigh just 6 lbs. each. Accessories are available to meet any drilling requirement.

Send $1.00 for complete 24-page illustrated portable drilling manual.

Basic Kit, complete with drill and pump **$885** **F.O.B. Spokane. Rods and Bits additional.**

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Open Top and Sides Permit:
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See how easily you can observe every phase of the operation of this open-type heavy-media vessel, and how readily it can be maintained. Then investigate: (1) Its simplicity; entire process is performed by one moving part; little to go wrong. (2) Its quiet pool surface with large productive separating area. (3) Its unique drive; no power transmission trains. (4) Its low installation cost. Examination will disclose this vessel's substantial economies in production and maintenance. Models for all HM needs.

Our pilot plant houses commercial-size HMS system

For details of OCC Vessel's unprecedented simplicity, Send for HMS Bulletin. Pilot plant testing service

THE ORE & CHEMICAL CORP.
DIVISION MINING & MILLING MACHINERY

80 Broad St., New York 4, N. Y.

Yuba *(Continued)*

Division manager, Clarence Carlson, and Exploration director, J. J. Theissen, are now planning Yuba's mining schedule to greatly increase the life-span of both the gold mining operations and the company's tin dredge which was to cease operations late in 1958.

Sittig to Conduct ACS Alkali Metals Meeting

MARSHALL SITTIG, president and managing director of the American Lithium Institute, Inc., has been appointed chairman of a symposium on alkali metals to be conducted at the 133rd national meeting of the American Chemical Society, slated for San Francisco, April 1958.

Besides lithium, sodium, potassium, rubidium, cesium and francium will be discussed and examined. Tentative subject titles include: the outlook for lithium in alloys; new developments in liquid metals handling equipment; sodium as a nuclear reactor coolant, manufacture of titanium by sodium reduction; large-scale manufacture of sodium borohydride; and the outlook for rubidium and cesium metals.

American Metal, Climax To Vote Merger Deal

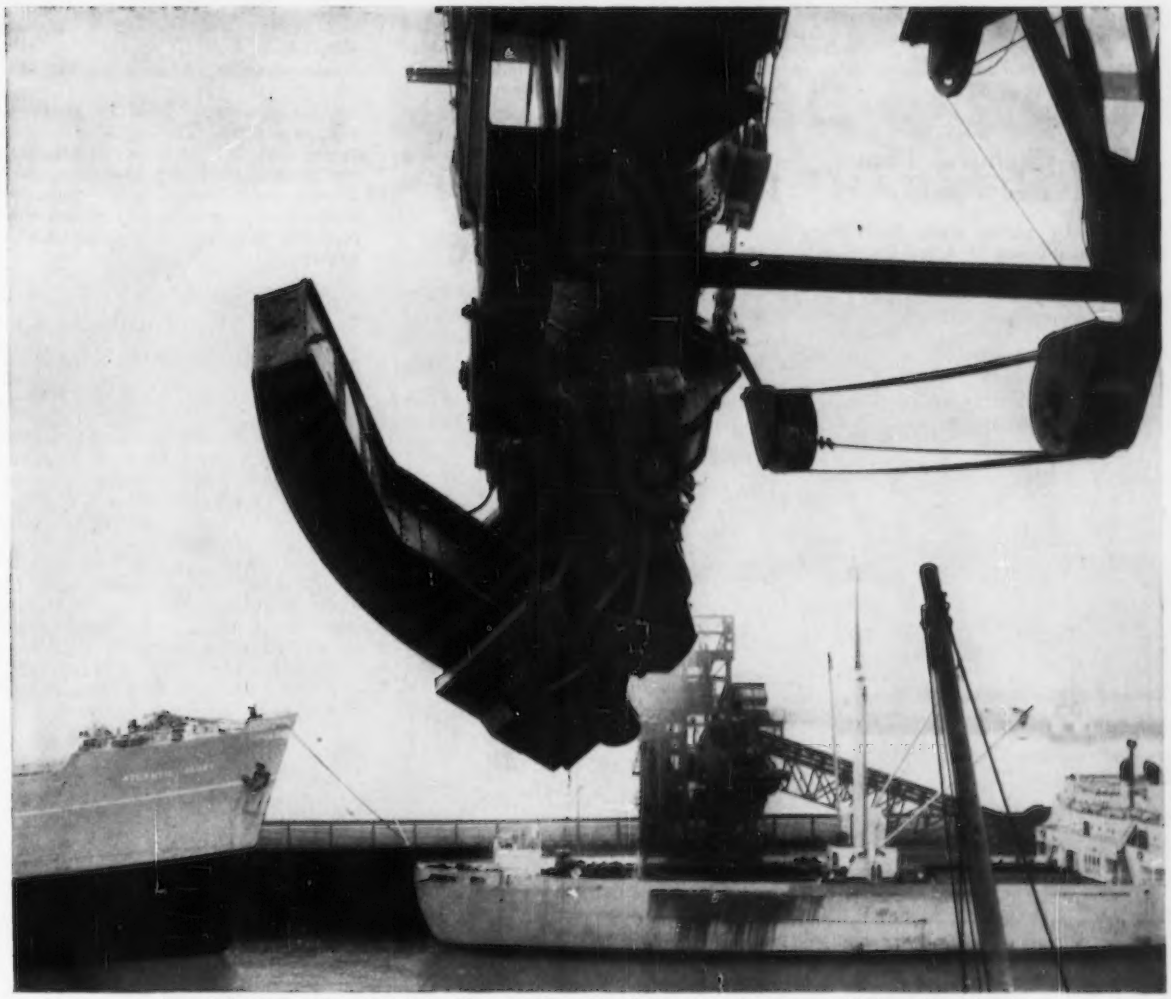
AMERICAN METAL CLIMAX, INC. will be the name of the surviving company if a proposed merger of American Metal and Climax Molybdenum Co. is approved by the companies' stockholders.

Merger was proposed by the directors of the companies and announced jointly. Under the new organization, Harold K. Hochschild, honorary chairman of American Metal, would retain that title. Arthur H. Bunker, now president of Climax, would become chairman. Hans A. Vogelstein, president of American Metal, would head the new concern.

Million-Acre Survey Is Under Way in Maine

MAINE'S GEOLOGICAL SURVEY, a division of the Department of Economic Development, has undertaken an aeromagnetic and geologic reconnaissance survey of an area comprising one million acres in south central Maine. The project has been contracted to the James W. Sewall Co., Consulting Engineers, Old Town, with the aeromagnetic survey sub-contracted to Aerogeophysics, Inc., Los Angeles.

Survey includes three widely spaced groups of long flight lines with fill-in in anomalous areas. Geologic mapping includes compilation of reliable data from various published and unpublished sources in addition to reconnaissance mapping on the ground and from the air. John R. Rand, State Geologist, anticipates that the survey will be com-



At world's most modern coal docks, Newport News, Va., C&O uses coal trimmers of Lukens "T-1" Steel.

New Coal Loading Machine is tougher and lighter—made with Lukens "T-1" Steel

TRADEMARK

Tough, weight-saving Lukens "T-1" gives this trimmer added mobility.

When the C&O Railway designed this huge new coal trimmer, they chose Lukens "T-1" steel for its combination of high strength and toughness—plus ready workability. Construction required less steel, produced outstanding abrasion resistance.

Now with stepped up efficiency, this mammoth machine easily and economically deposits 2,000 tons of coal an hour deep in the holds of ships—with a minimum of wear and maintenance.

Whether you handle coal, stone, gravel or metal ores, Lukens "T-1" steel used in areas hardest hit by punishing abrasive impact will save you money, too. It has tripled the life of rock driers. The 321 minimum Brinell quality has been known to outlast previous metals by 18 to 1 in quarry wear plates. Chutes, hoppers, and mine cars are other typical applications.

And Lukens "T-1" steel retains its remarkable toughness at temperatures well below zero. Send for our informative illustrated booklet, "Lukens 'T-1' Steel." Write Manager, Marketing Service, Room 959, Lukens Steel Company, Coatesville, Pennsylvania.

LUKENS

Helping industry choose steels that fit the job

Maine *(Continued)*

pleted for a release date late in February 1958.

Allied Chemical Plans Spent Acid Facility

PLANS ARE BEING MADE by General Chemical division of Allied Chemical & Dye Corp., to build a sulphuric acid plant at Anacortes, Wash., to supply refineries, paper mills and other industries in the Puget Sound area.

Allied Chemical said the plant will include "the most modern spent acid decomposition facilities available" and will have hydrogen sulphide recovery facilities—equipment permitting recovery of sulphur values from refinery sludge and waste gases for use in place of refined sulphur or sulphur bearing ores.

Kaiser Signs Fluoride Contract With IM&CC

KAISER ALUMINUM & Chemical Corp. will buy more than 10,000 tons of a fluoride compound annually under a multimillion-dollar, five-year contract with International Minerals & Chemical Corp., Chicago.

According to International, the contract provides only part of Kaiser's needs for the acid at its plant in Mulberry, Fla., which went into production last spring using fluoride output of neighboring plants. Increasing aluminum production could require early expansion of the Mulberry plant and greater supplies of fluosilicic acid, said Kaiser officials.

Harvey Aluminum Seeks Jamaican Bauxite Ore

HARVEY ALUMINUM, division of Harvey Machine Co., has entered into a two-year agreement with the Jamaican government to prospect for bauxite on the 600 square miles of government land in Jamaica. The license is renewable for another three years after the two year period is up.

A company official said Harvey needs about 300,000 tons a year of bauxite to supply its aluminum plant at The Dalles, Ore. Should the company find enough bauxite in Jamaica to supply its needs, a spokesman said, it will probably build an alumina plant adjacent to its aluminum plant at The Dalles.

Rico Argentine Mining Suspends Metal Output

RICO ARGENTINE MINING CO., famous western Colorado lead-silver-zinc producer, has suspended all metals production at its Rico, Colo. mine and mill, according to Sherman B. Hinckley, Salt Lake City, president and general manager.

The firm continues the mining of pyrites and production therefrom of sulphuric acid. It also is carrying on some development work in its metals mine in hopes of tariff action on lead and zinc by Washington.

Shut down of metals output was effective last June. First announcement by the firm of this action came three months later in an annual report addressed to shareholders.

At the stockholders' meeting, board chairman James E. Hogle, said that Rico was completing a "period of transition." He disclosed that production at the sulphuric plant had been increased from "between 10 to 170 tons a day to 200 tpd." The company is now mining its pyrite feed for the plant, rather than converting pyritic tailings. The reason for this was that super-fine tailings encountered in running this form of pyrite caused difficulty in the H_2SO_4 roaster, Hogle said.

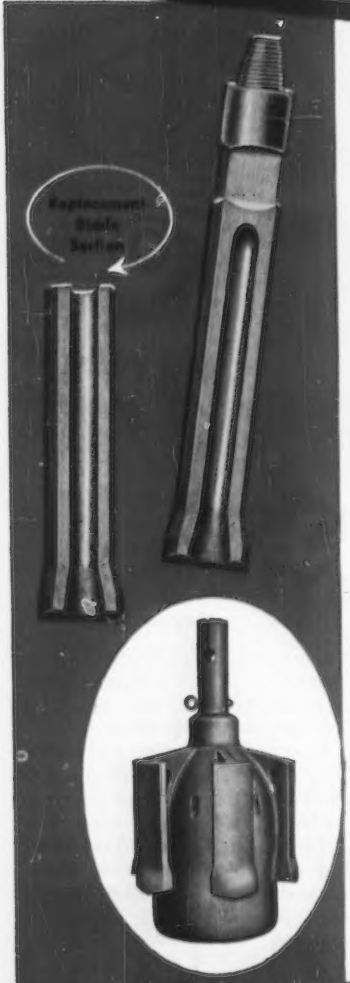
He said an oversized crusher had been installed to handle mine production of pyrites. Size of the crusher permits the company to operate only one shift in the mine but at the same time provide sufficient feed for around-the-clock production of sulphuric acid.

The sulphuric is sold to uranium mills in the area.

SPANG

BLAST HOLE BITS

Drill More Holes Per Bit, At Less Cost Per Hole



SPANG CHURN DRILL BITS, famous for long life and economy in the drilling of blast holes for the fragmentation of minerals or overburden, drill *more-holes-per-bit* at *less-cost-per-hole*, because they are fully heat-treated from end to end and have the *extra strength in pin and blade sections* to stand up under the toughest drilling conditions. They are made with semi-dressed ends for quicker, easier finish-dressing, in High Carbon, A.I.S.I. 4340, and Spang Molloy Steel.

Available also, as an added economy, are SPANG REPLACEMENT BLADE SECTIONS in the same grades of steel, and uniform forge section, for welding to pin and collar sections of original bits when long service has worn the integral blade to a point where replacement is desirable.

Anyway you look at it, SPANG BITS are your best buy for more holes at less cost per hole.

SPANG REAMER TYPE PILOT BITS FOR DRILLING LARGE DIAMETER HOLES

Can be supplied in all sizes and in any practical weight.

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The HIGHER STANDARD

SPANG

AMSCO TUBE ◉ RODS

for semi-automatic HARDFACING

The perfect uniformity of Amsco Tube Rod insures smooth, trouble-free feed to the work. Note hardfacing alloy compactly enclosed within the steel tube.

Here are new, improved tube rods . . . *specially designed and engineered* for semi-automatic hardfacing! They have *proved* their speed, quality of weld and uniform deposit in actual use tests. In many cases, deposition rate has been increased up to 200% over other types of semi-automatic electrodes.

Amsco® Tube Rods are perfectly symmetrical, steel-shell wires, with the various alloys firmly enclosed and evenly distributed, for proper weld deposit. The steel shell is work-hardened to provide rods that will not deform or snarl during welding . . . that will run well in any semi-automatic welder. The rods are pre-lubricated, to insure constant and uninterrupted feeding to the work.

For additional information and technical data on Amsco Tube Rods or the Amsco MF Semi-Automatic Welder, see your Amsco Welding Distributor. Or write to Amsco Welding Department SA, Chicago Heights, Ill.

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American Manganese Steel Division • Chicago Heights, Ill.

OTHER PLANTS IN: DENVER, LOS ANGELES, NEW CASTLE, DEL., OAKLAND, CAL., ST. LOUIS, JOLIETTE, QUEBEC

ON THE go

by J. Hall Carpenter

CARPCO IN THE FAR EAST. Charting progress in this part of the world will be the object of my trip this month. In Australia, if all goes on schedule, Carpco in Brisbane will be busy equipping the dry separation plant of the newest producer of ilmenite from Western Australia.

MALAYA AND SOUTHERN SIAM will also be visited where eighty-six installations of Carpco High Tension Separators are engaged in producing cassiterite as wel. as monazite and columbite in the many tin sheds there.

A study will be made of the best way in which Carpco may serve Korea's growing mineral industry particularly in rare earths and tungsten.

Another goal for this month will be to further the establishment of Carpco Hong Kong Ltd. to provide a focal point for Carpco engineering and equipment services for the Far East.

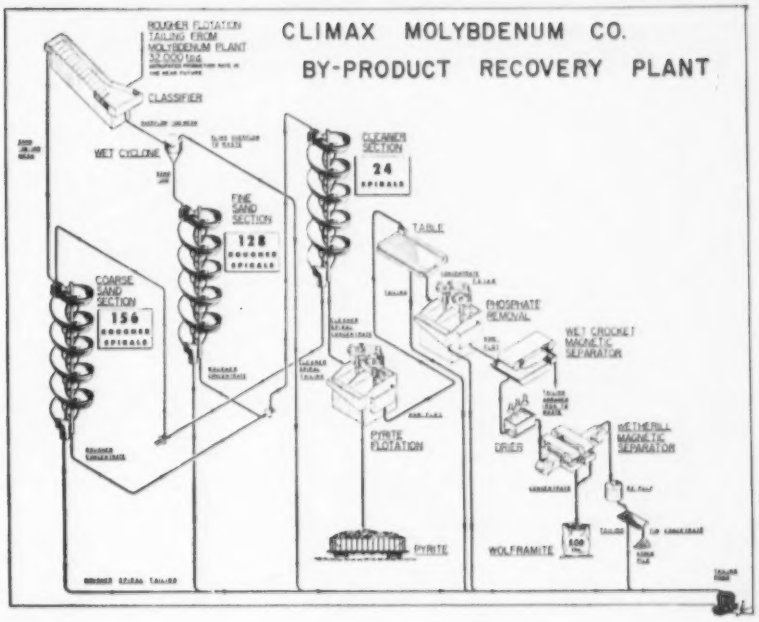
Visiting the Philippine Islands, where Carpco pilot plant equipment is being used for study of the production of high grade chromite, will also be on the agenda—the entire mining industry of the Philippines is aggressively moving forward into the production of new minerals and the expansion of mining projects.

We at Carpco would like to take this opportunity to wish all our friends in the mining industry a

Merry Christmas and a Happy New Year

Carpco

CARPCO RESEARCH AND ENGINEERING • CARPCO MANUFACTURING, INC.
CARPCO CONSTRUCTION CORPORATION • CARPCO EXPORT CORPORATION
JACKSONVILLE, FLORIDA, U. S. A.



E&MJ's Flowsheet Design Book

THE BEST WAY TO DESIGN a flowsheet is to discover how others solved the same or similar problems. That's the purpose of the next 15 pages — to provide you with a quick, ready guide to flowsheet design. Not all metal and mineral processing is confined to the realm of the newer, more exotic methods — ion exchange, resin-in-pulp, solvent extraction, hydrometallurgy, high pressure-high temperature leaching. We still rely on the basic, bread-and-butter techniques developed over the years — jigs, tables, magnets, flotation cells, heavy media, screens, logwashers, high-tension electrostatics and spirals — to name a few.

Flotation still dominates the field — more ore is floated at San Manuel (see p 146) in one day than is leached by all the U. S. and Canadian uranium mines in the same period. Electrical methods — magnets and high-tension statics — are increasing their treatment tonnage by leaps and bounds each year. Reserve Mining Co. (see p 150) has to grind 36,000 tpd through 300 mesh, then concentrate on magnets, and finally pelletize to put the iron back together for the blast furnace. And Erie Mining Co.'s project will be larger than Reserve's.

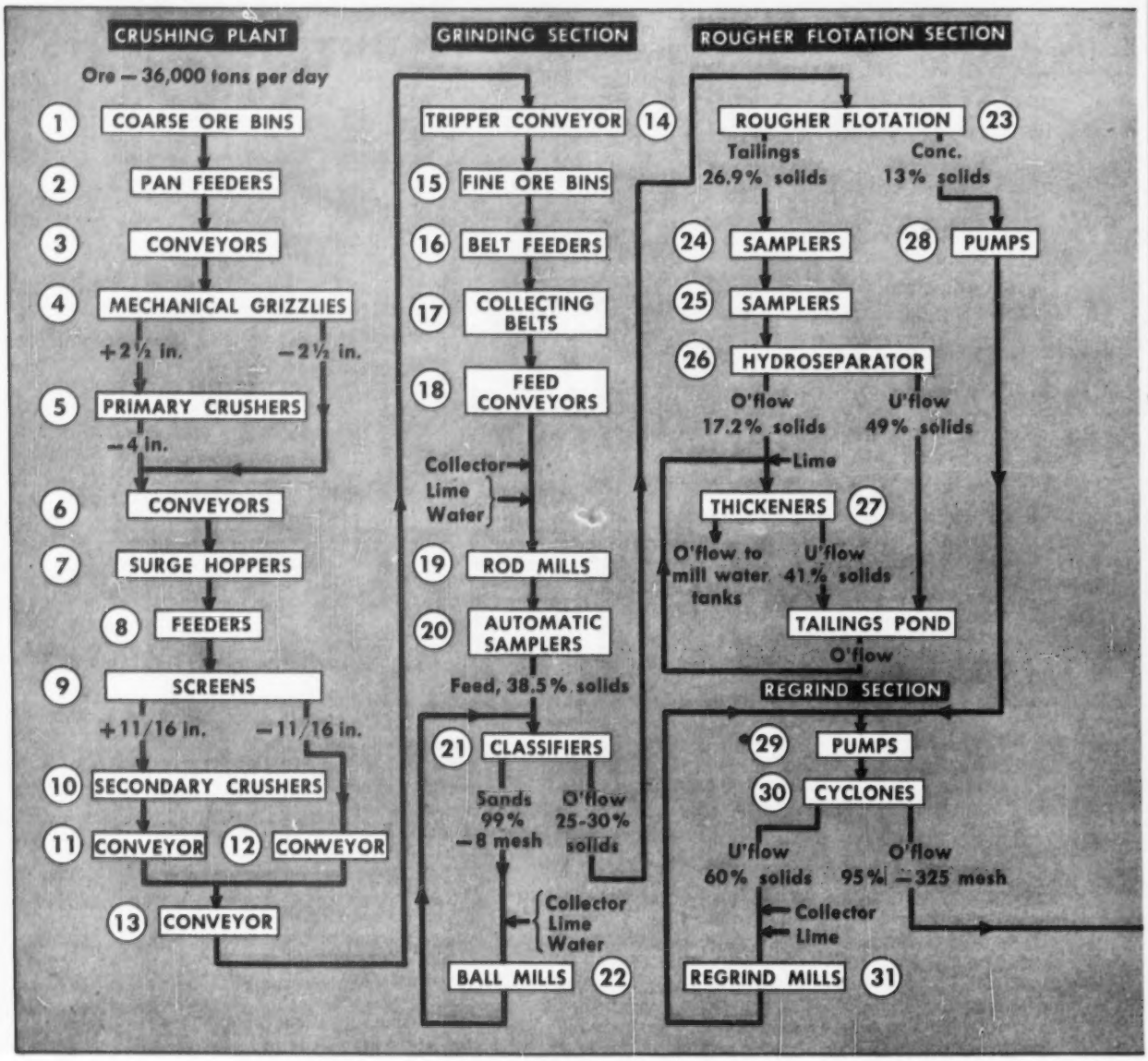
During 1957, *E&MJ* covered the following metal and mineral process developments to keep you abreast of changing times, each of which is a guide to designing future processes:

Anaconda's Aluminum Plant. Jan p 80
Annual Review. Feb p 128 and 132
Allis-Chalmers Pelletizing Process. Oct p 75
Alumina Jamaica, Sept p 86
AS&RCo's Molybdenite Circuit. Aug p 104
Bagdad Reports on Progress. July p 86
Bethlehem Steel Manganese Patent. July p 101
Catavi Cassiterite Concentrator. Nov p 100
Coming — Revolution in Steel-Making. Jan p 99
Electrolytic Zinc's Roaster. Oct p 78
Flin Flon Zinc Fuming. June p 82
FluoSolids at Dalny Mine. May p 98
Gorno's Oxidized Zinc Process. April p 82
Homestake's Gold Mill. May p 91
How to Reduce Gold Losses. June p 101
How to Select Conveyor Belt. May p 75; July p 94
Inverted Bosh Blast Furnace. Aug p 100
Iron Ore Benefication. Mar p 96
Marquette Iron Ore. Jan p 76
Moab Uranium Mill. Jan p 90
New Look at Slag Fuming. Mar p 90
Nicaro Nickel. Sept p 82
Non-Cataracting Ball Mill. Mar p 98
Ore Dressing at Stockholm Meeting. Nov p 79
Oxidized Copper Processes. Mar p 80
Planning Cuba's Second Nickel Mine. Sept p 78
Processing Alluvial Sands. April p 93
Vertical Casting Wheel. April p 75

In addition to these, *E&MJ* provided additional metal and mineral processing design information in the Mid-June 1957 *E&MJ Mining Guidebook* -- flotation machines, pp 82-84; mineral separation characteristics, p 85; how to get the most out of a wet cyclone, pp 86-91; crusher sizes, pp 92-95; filters for concentrate or process water, pp 96-99; dust collector types, pp 100-103; solvent extraction, pp 104-105; solid-gas contacting equipment, pp 106-111; agglomerating-pelletizing, pp 112-117; and chemical metallurgical flowsheets, pp 118-123.

To round out the year, we've prepared this 16-page flowsheet design book from the best available flowsheets featuring modern process techniques on a variety of metals and minerals. Flowsheets covering copper flotation, gold roasting, flotation and cyanidation, gold amalgamation and cyanidation, magnetic separation and pelletizing of magnetic taconite, emulsion flotation of manganese, molybdenite recovery, germanium precipitation, zinc fuming and combined leach-float for potash are included.

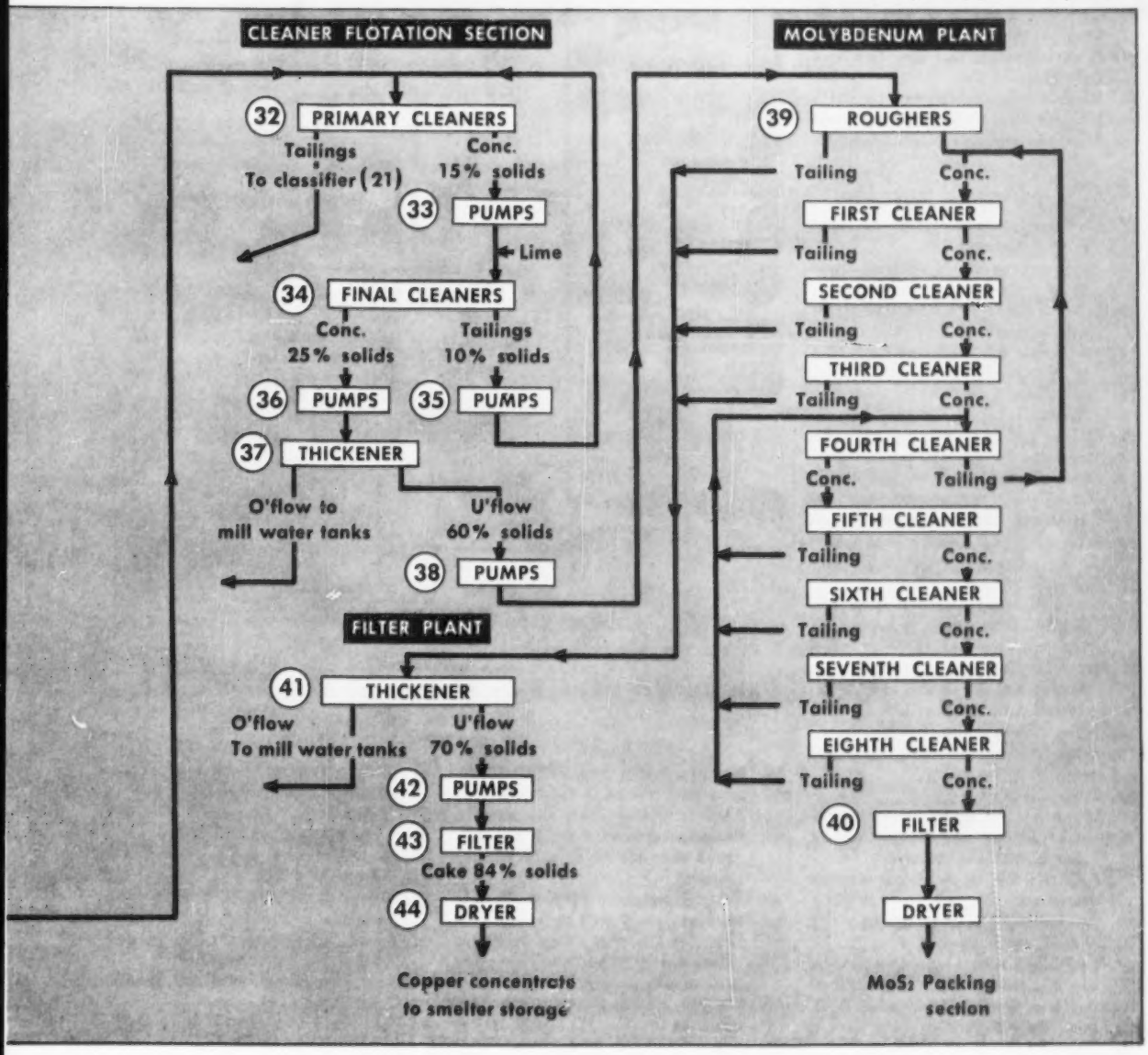
Each flowsheet represents a large and going operation. Where better to find out how to do it than from an experienced operator? File this issue, containing 26 up-to-date flowsheets, with your copies of past *E&MJ Mining Guidebooks* for future reference in designing your next metal and mineral process.



San Manuel Copper Co. Floats 36,000 tpd, Recovers a 25% Copper

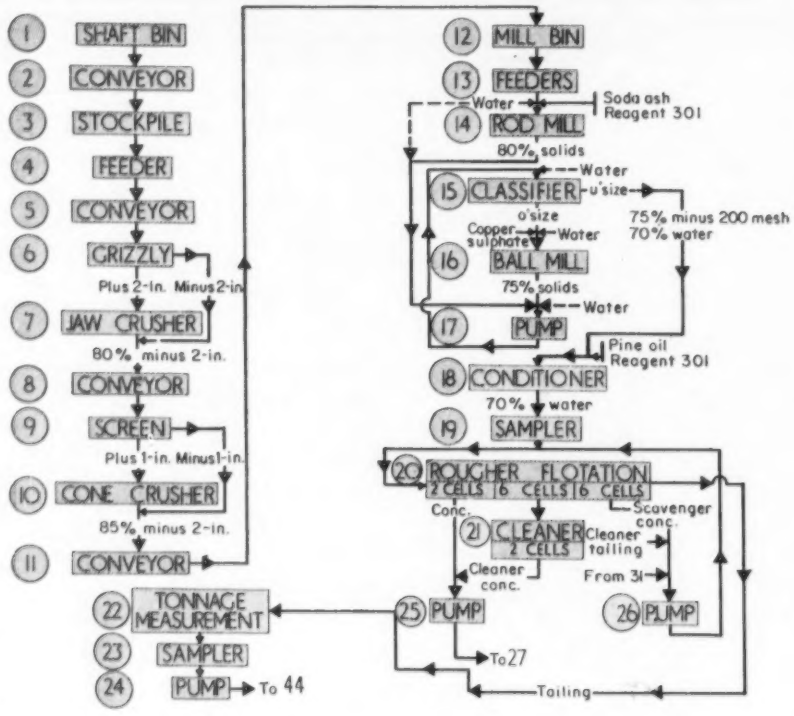
LEGEND

1. Coarse ore bins, 10,000-ton capacity
2. Eight pan feeders, 48 in. x 16 ft
3. Conveyors: Four 48-in. collecting conveyors, 500 tph each at 250 fpm. Two 48-in. impact conveyors, 1,000 tph each at 250 fpm. Two 48-in. conveyors to primary crushers, 1,000 tph each at 250 fpm. Two 72-in. picking conveyors, 1,000 tph at 150 fpm
4. Two mechanical grizzlies, bar spacing 2½ in.
5. Two Symons crushers, 7-ft standard
6. Conveyors in sequence: One 60-in. impact conveyor 2,000 tph at 425 fpm. One 54-in. conveyor to transfer house, 2,000 tph at 425 fpm. One 54-in. cross conveyor, 2,000 tph at 425 fpm. One 54-in. tripper conveyor to surge hoppers, 2,000 tph at 425 fpm
7. Four surge hoppers, 200-ton capacity each
8. Four 48-in. x 15-ft 6-in. belt feeders, 500 tph at 120 fpm
9. Four 6x12-ft vibratory screens
10. Four Symons 7-ft shorthead crushers
11. Impact conveyor, 60-in., 1,272 tph at 250 fpm
12. Conveyor, 48-in., 728 tph at 250 fpm
13. Conveyor, 54-in. to fine ore angle station, 2,000 tph at 450 fpm
14. Tripper conveyor, 54-in., 2,000 tph at 450 fpm
15. Fine ore bins, 45,000-ton capacity
16. Thirty-two 36-in. belt feeders, 4 per section. One feeder in each section to be controlled by weightometer on rod mill. Feed belt 41.67 tph, constant speed belt, 15 fpm
17. Eight 24-in. collecting belts, 166.8 tph at 226 fpm
18. Eight 24-in. feed conveyors, 166.68 tph each at 231 fpm. Regulating weightometer on each conveyor



Sulphide Concentrate and a 90% Molybdenite By-Product

19. Eight 10x13-ft rod mills, 65% solids —8-mesh, 610.4 gpm discharge
20. Eight automatic samplers. Samples go to laboratory
21. Sixteen rake classifiers 16x35-ft
22. Sixteen ball mills 10x10-ft
23. Rougher flotation. Four sections, 6 machines, 120 cells each section, 357 tph per section
24. Four tailings samplers, one for each section
25. One tailings sampler for combined tailings
26. Hydroseparator, 55-ft dia x 12 ft
27. Three 325-ft dia thickeners
28. Four pumps, one for each rougher section
29. Four pumps, one for each regrind section cyclone feed
30. Twenty 12-in. cyclones, 5 per section. One in each section is a stand-by unit. Feed 17% solids, 62.4 tph per section
31. Four 8x12-ft regrind ball mills. Discharge 31.2 tph at 60% solids
32. Primary cleaner. Four sections, 39 tph per section, 8.2% solids
33. Four pumps, 1 per section
34. Four final cleaner flotation sections
35. Tailings go through sample cutters and pumps to primary cleaners
36. Cleaner concentrates go through automatic samplers and pumps to molybdenum plant
37. One 100-ft dia thickener
38. Underflow goes through diaphragm pumps, to pump box, to centrifugal pumps, to sampler to rougher flotation cells
39. Rougher flotation cells
40. Filter, 4-ft dia, 2 disks
41. Thickener, 100-ft dia
42. Underflow goes through diaphragm pumps, to distributor box, to filters
43. Three 6-ft dia, 8-disk, filters
44. Two multiple hearth furnaces



Numbers in the legend apply to both flowsheets

1. Bin, capacity—50 tons
2. 36-in. conveyor at 150 fpm, capacity—100 tph
3. Stockpile, capacity—550 tons
4. 36-in. Geoffrey-Gallion vibrating feeder
5. 30-in. conveyor at 150 fpm, capacity—80 tph
6. Grizzly, 7-ft 9-in. by 3-ft 6-in.—2-in. spacing
7. 12x30-in. jaw crusher made by Fraser & Chalmers
8. 24-in. conveyor at 250 fpm, capacity—80 tph
9. 3x8-ft Symons rod-deck vibrating screen—⅜-in. spacing
10. 4-ft Symons shorthead cone crusher set to ½-in.
11. 24-in. conveyor at 300 fpm, capacity—80 tph
12. Circular bin 41-ft 6-in. by 30-ft dia, capacity—1,440 tons
13. 24-in. Harding constant-weight feeder; 12-in. Geoffrey-Gallion feeder; and 24-in. belt feeder with adjustable gate
14. 5x12-ft rod mill made by Issels & Son Ltd.; Bulawayo. 23 rpm. 3-in. high-carbon steel rods
15. 5-ft Akins high-weir, duplex spiral classifier made by Vector Equipment Co., Ltd.
16. 8x8-ft ball mill (grate discharge) made by Vector Equipment Co., Ltd. 22-rpm. 2½-in. white cast-iron balls
17. 2x6-in. Wilfley pumps. One standby
18. 8x8-ft Denver conditioning tank. 210 rpm
19. 24-in. Galigher sampler
20. 14-cell No. 36 Agitair roughing flotation machines with Sutorbilt blower, size 8L, 480 rpm, 800 cfm
21. 2-cell No. 36 Agitair cleaner flotation machine
22. Tonnage tank, 10-cu ft capacity
23. 24-in. Galigher sampler
24. Two 4-in. Wilfley pumps. One stand-by
25. Two 2-in. Wilfley pumps. One stand-by
26. Two 2-in. Wilfley pumps. One stand-by
27. 24-in. Galigher sampler
28. Tonnage tank, 10-cu ft capacity
29. Dorr-type, central shaft thickener, 25-ft dia, 8-ft 6-in. high, Vector Equipment Co. Ltd. With 2-in. Dorrco duplex diaphragm pump for circulating pulp
30. Mono pump, No. D-10-D. For feeding stock tank
31. Two cone classifiers, 5-ft dia by 60 deg
32. Stock tank, 8-ft dia by 13-ft 6-in. high, with stirrers at 6 rpm and 20 cfm air at 40 psi for air lift
33. Mono pump, No. D-12 with variable speed drive for feeding to roaster
34. FluoSolids 2-compartment roaster, 16-ft dia by 20-ft high
35. Five quench tanks, 30-in. dia by 4-ft sides with 45 deg cone bottom. Air agitated
36. Two 2-in. Wilfley pumps. One stand-by
37. Cyclone, 10-in. dia, 20 deg cone
38. 4-ft 6-in. Hardinge ball mill on 34 rpm
39. Two 2-in. Wilfley pumps. One stand-by
40. James sand table, 6-ft deck width
41. Two 2-in. Wilfley pumps. One stand-by
42. Amalgamating barrel, 2-ft dia, 3-ft long, at 34 rpm with four 3-in. dia rods for regrind
43. Amalgamating plate, 5-ft x 2-ft 6 in.
44. Dorr-type central shaft thickener, 75-ft dia, 8-ft 6-in. high. Made by Vector Equipment Co. With 4-in. Dorrco triplex diaphragm pump
45. Two 4-in. centrifugal water pumps. One stand-by
46. Cyclone, 10-in. dia, 20-deg cone
47. Two 3-in. Wilfley pumps. One stand-by
48. Five Pachuca tanks, 15-ft dia by 45-ft high
49. Two Oliver-type drum filters, 14-ft dia by 16-ft long. Fraser & Chalmers, Ltd.
50. Dorr-type central shaft thickener, 25-ft dia by 8-ft 6-in. high. Vector Equipment Co. With 2-in. Dorrco diaphragm pump
51. Two 1-in. Wilfley pumps. One stand-by
52. Seven Wallace-type agitators in series, 12-ft dia by 12-ft high. 2,000 rpm
53. Dorr-type central shaft thickeners, 25-ft dia by 8-ft 6-in. high. Vector Equipment Co. With 2-in. Dorrco duplex diaphragm pump
54. Oliver-type drum filter, 6-ft dia by 7-ft 6-in. long. Vector Equipment Co.
55. 24-in. Galigher sampler
56. Two 1-in. centrifugal pumps. One stand-by
57. Two clarifying tanks, 25-ft dia by 7-ft high, with 3-in. bed of fine sand
58. Merrill-Crowe clarifying leaf filter with twelve leaves, each 12x12-ft
59. Merrill-Crowe de-aerating tower, 6-ft dia by 12-ft high
60. Two 4-in. centrifugal pumps. One stand-by
61. Johnson filter press with 30 leaves, each 3x3-ft
62. Lea recorder for measuring solution tonnage
63. Two barren solution tanks, 12-ft dia by 8-ft high
64. Three 2-in. centrifugal pumps. One stand-by
65. Two 6-in. Wilfley pumps. One stand-by
66. Two 2-in. Wilfley pumps. One stand-by

Falcon Mines Ltd. Uses FluoSolids Roasting Combined

Compressor—Vacuum Pump Data

Air Compressors

One Broom & Wade compressor, 10.5-in. bore, 12-in. stroke, 50 psi

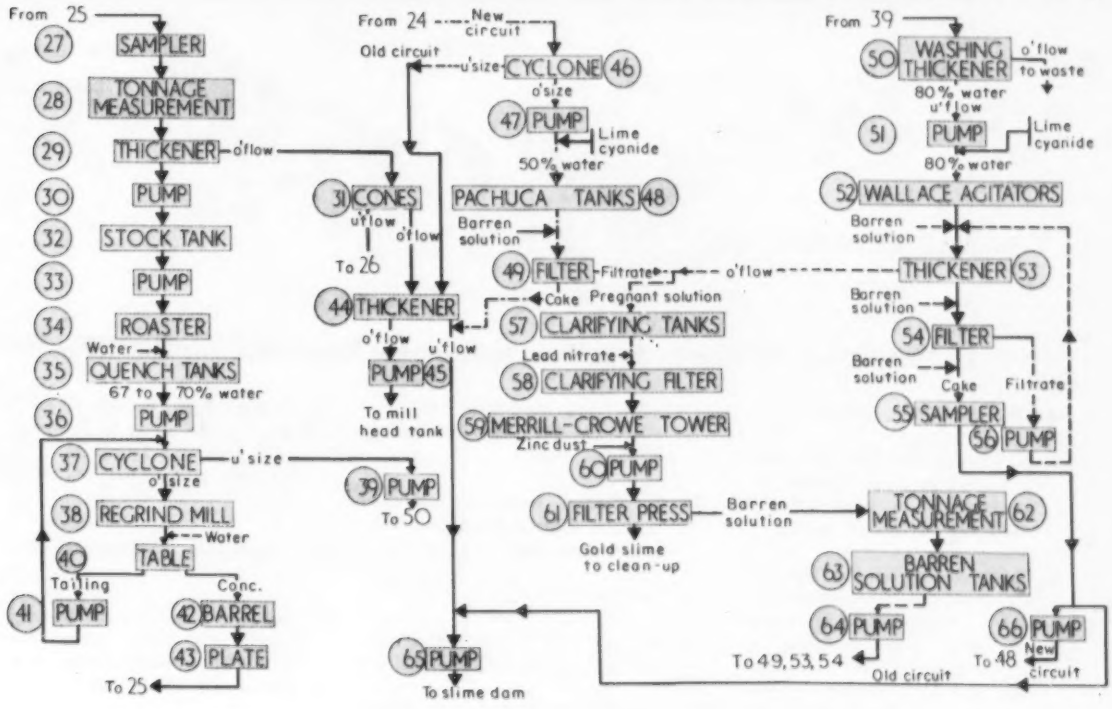
Two Broom & Wade compressors, 6-in. bore, 6.5-in. stroke, 50 psi

Vacuum Pumps

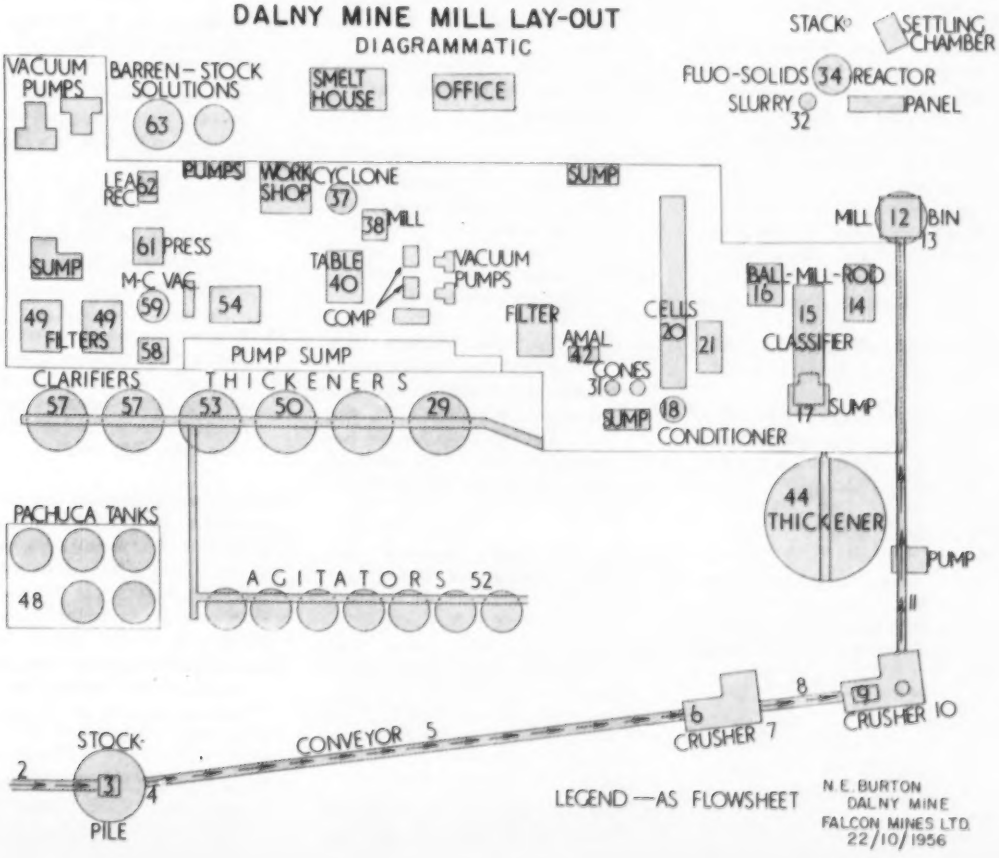
Two Ingersoll-Rand vacuum pumps, 23-in. bore, 14-in. stroke, for the filters

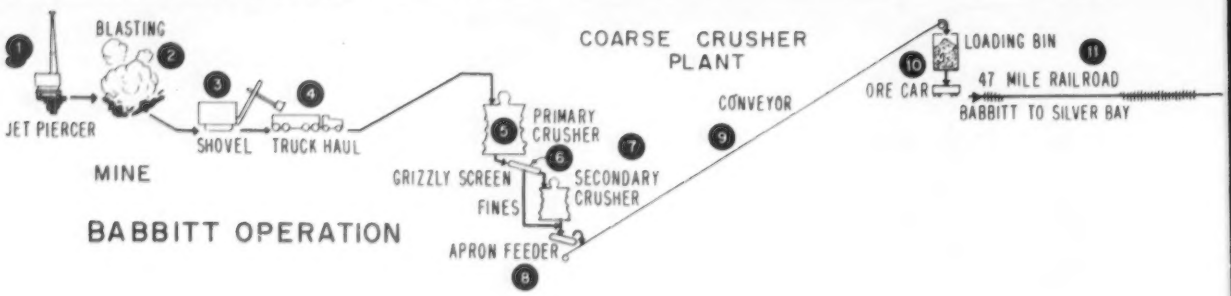
One Worthington-Simpson vacuum pump, 22-in. bore, 9-in. stroke, for the filters

One Oliver United Filter Corp. vacuum pump, 7¾-in. bore, 4-in. stroke, for the Merrill-Crowe tower



With Flotation and Cyanidation to Recover Gold at Dalny Mine





Reserve Mining Co. Grinds to 300 Mesh to Liberate Magnetite for the Magnetic

KEY TO DIAGRAM ABOVE:

1. **Jet piercing unit.** Sinks 40-ft holes 3 ft below pit grade. Diameter, approximately 7 in. Holes drilled in single row on 18x22-ft pattern.

2. **Blasting.** High-velocity, high-density, insensitive water-resistant explosive. Holes are double-primed with double strand of prima-cord connected to trunk line which contains 17-milli-second delay between each hole. Secondary breakage with 6½-ton drop ball on crawler crane.

3. **Electric shovel,** 7-yd with 5-yd manganese steel dipper.

4. **Tractor-trailer.** Side-dump units are powered by 300-hp diesel engine. Capacity, 45 long tons. Trailers are unloaded at crusher pit with stationary overhead push-button hoist which raises side-dump bodies with hooks.

5. **Gyratory crusher.** Sixty-inch unit powered by two 500-hp motors. Reduces mine run to minus 9 in. Capacity 3,500 long tons per hour.

6. **Grizzly screen.** Undersize of minus 4-in. goes to belt.

7. **Secondary crushers.** Four 30-in. gyratory units, each powered by a 300-hp motor. Product is minus 3-in. One unit is a stand-by.

8. **Pan Feeder,** 84-in.

9. **No. 1 conveyor.** Steel-cable-reinforced belt powered by three 400-hp motors. Capacity 3,000 long tons per hour. Working tension 120,000 lb.

10. **Loading bins.** Two 40x150-ft bins with total capacity of 9,800 long tons. Cars, 85-long ton capacity, are loaded at rate of one every two minutes.

11. **Railroad.** Babbitt to Silver Bay, 47 miles. Train consists of 110 flat-bottom gondolas each with capacity of 85 long tons.

12. **Car dumper.** Rotary unit with 29-ft 4½-in. diameter. Can dump 4,000 long tons per hour.

13. **Pan feeder,** 84-in.

14. **Conveyor No. 2.** Belt is 60-in. by 312 ft, driven by 500-hp motor.

15. **Conveyor No. 3.** Two 66-in. shuttle belts.

16. **Fine crushing storage bins.** Four 40-ft diameter by 100-ft high bins, each with capacity of 4,800 long tons.

17. **Four pan feeders** with variable-speed drive.

18. **Conveyor No. 4.** Four 36-in. by 140-ft belts each carrying up to 600 tons per hour to each fine crushing section.

19. **First stage screening.** Four 6x12-ft double-deck vibratory screens.

20. **First-stage fine crushers.** Four 7-ft shorthead cone crushers reduce taconite to minus 1¼-in. Each crusher section crushes at the rate of 450 tph. (Two screens and two crushers in each of the four sections.) Driven by 300-hp V-belt motor.

21. **Second stage screening.** Four 6x12-ft double-deck vibratory screens.

22. **Second-stage fine crushers.** Four 7-ft shorthead cone crushers reduce taconite to minus ¾-in. Each section crushes at rate of 450 long tons per hour. Driven by 300-hp V-belt motor.

23. **Conveyor No. 5.** Belt 60-in. by 165-ft carries 3,000 long tons per hour.

24. **Conveyor No. 6.** Belt 60-in. by 485-ft carries minus ¾-in. material under highway at rate of 3,000 long tons per hour. Driven by 300-hp motor.

25. **Transfer bin,** 40-ft diameter, 30-ft high.

26. **Conveyor No. 7.** Belt 48-in. by 1,200-ft with tripper having travel of 975 ft. Distributes crushed taconite to mill storage bins.

27. **Mill storage bins.** Twenty-four 40-ft diameter, 50-ft high with capacity of 3,000 long tons each.

28. **Conveyor No. 8.** Forty-eight variable speed 30-in. belts.

29. **Conveyor No. 9.** Twelve 24-in. belts carrying 155 long tons per hour of minus ¾-in. feed to rod mills.

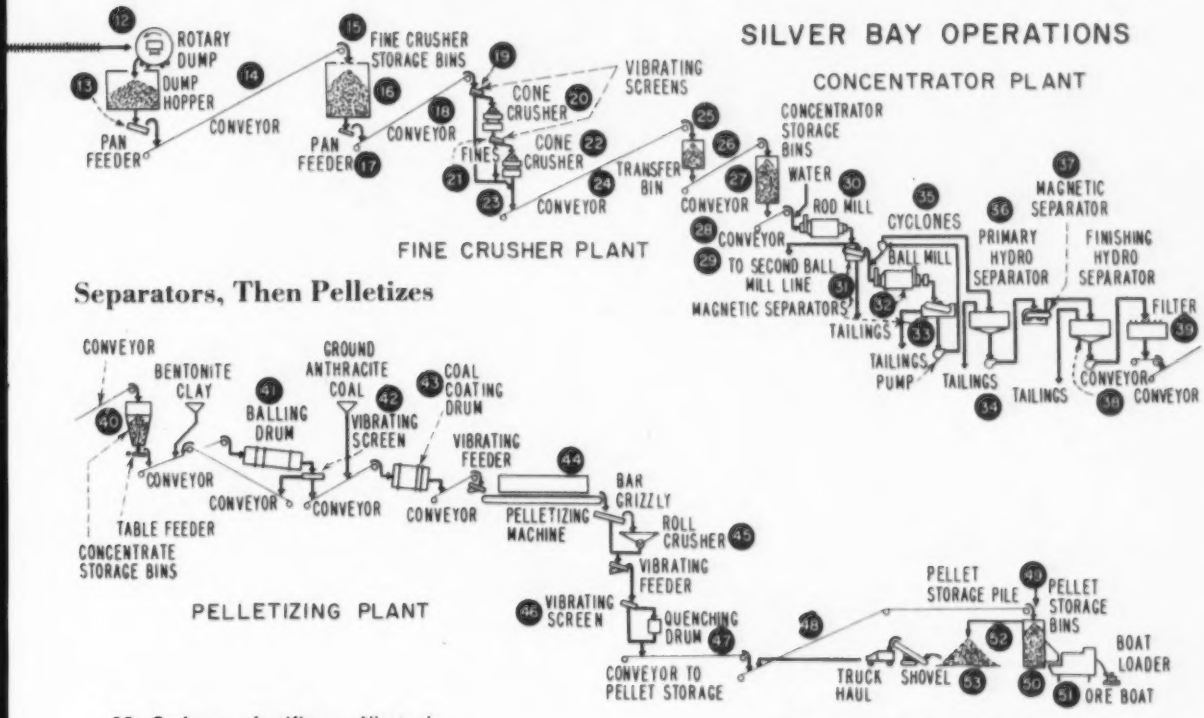
30. **Rod mills.** Twelve 10½-ft diameter by 16-ft long. Grind to minus 10-mesh at rate of 140 long tons per hour. Rotate at 15 rpm. Driven by 800-hp motors.

31. **Cobbing magnetic separators.** Twenty-four belt-type, two-drum units with capacity of 70 long tons per hour each. Waste sand discharge is 35% of feed tonnage. Concentrate about 40% iron.

32. **Ball mills.** Twenty-four 10½-ft diameter by 14-ft mills grind taconite to 80% minus 325-mesh at rate of 50 long tons per hour. Rotate at 16 rpm. Driven by 800-hp. synchronous motor.

33. **Rougher magnetic separators.** Ninety-six 48-in. inclined belt type. Each has capacity of 12 long tons per hour.

34. **Sand pumps.** Twenty-four 8x12-in. rubber-lined pumps which move product from rougher separator to cyclone classifiers.



Separators, Then Pelletizes

35. Cyclone classifiers. Ninety-six classifiers in two banks (8 per section.) Underflow goes to ball mills, overflow of 53% iron, 85% minus 325 mesh, flows to primary hydro-separators.

36. Primary hydro-separators. Twenty-four 16-ft diameter thickener type. Underflow pumped to finishing magnetic separators. Overflow discharged as waste sand.

37. Finishing magnetic separators. Seventy-two double-drum units, each with capacity of 7 long tons per hour. Concentrate 62.5% iron flows to finishing hydro-separators.

38. Finishing hydro-separators. Twenty-four 16-ft diameter thickener type.

39. Filters. Twelve disk-type vacuum filters. Discharge goes to conveyor No. 10; filtrate goes to finishing hydro-separator.

40. Concentrate storage bins. Three steel storage bins for each pelletizing machine (6 machines). Capacity 450 long tons each.

41. Balling drums. Three 9x30-ft long concrete-lined steel balling drums per pelletizing machine. Each of the three drums has a capacity of 30 to 40 long tons per hour, and rotates at about 10 to 11 rpm.

42. Vibrating screen. Undersize goes back to balling drum, oversize goes to 43.

43. Coal-coating drum. Three 8-ft diameter by 12-ft long coating drums for each pelletizing machine. Capacity of each drum is 30 to 40 long tons per hour, and rotation about 10.5 rpm.

44. Pelletizing machines. Six 6x168-ft windbox pelletizing machines having a normal capacity of 90 to 110 long tons per hour, and a normal grate speed of 60 in. per minute. Each machine equipped with 22 burners using No. 6 oil as fuel. Combustion is completed in about 6 minutes at a maximum temperature of 2,400 deg F.

45. Roll crusher. Somewhat clinkered pellets are put through roll crusher set at 4 in. prior to screening.

46. Vibrating screens. Single deck unit with screens set at 3/16-in. opening followed by 2-in. opening. Plus 2-in. is quenched. Minus 3/16-in. goes to spiral classifier which makes a 28-mesh separation. Plus 28-mesh goes with the finished pellets and minus 28-mesh goes to the reclaim section.

47. Conveyors AN and AS. Two 48-in. belts 660 ft long carry finished pellets to loading and storage area at a rate of 1,550 long tons per hour.

48. Conveyor C. Fifty-four-inch belt combines pellets from AN and AS and conveys them to junction house which feeds Conveyor D. Capacity 2,550 long tons per hour.

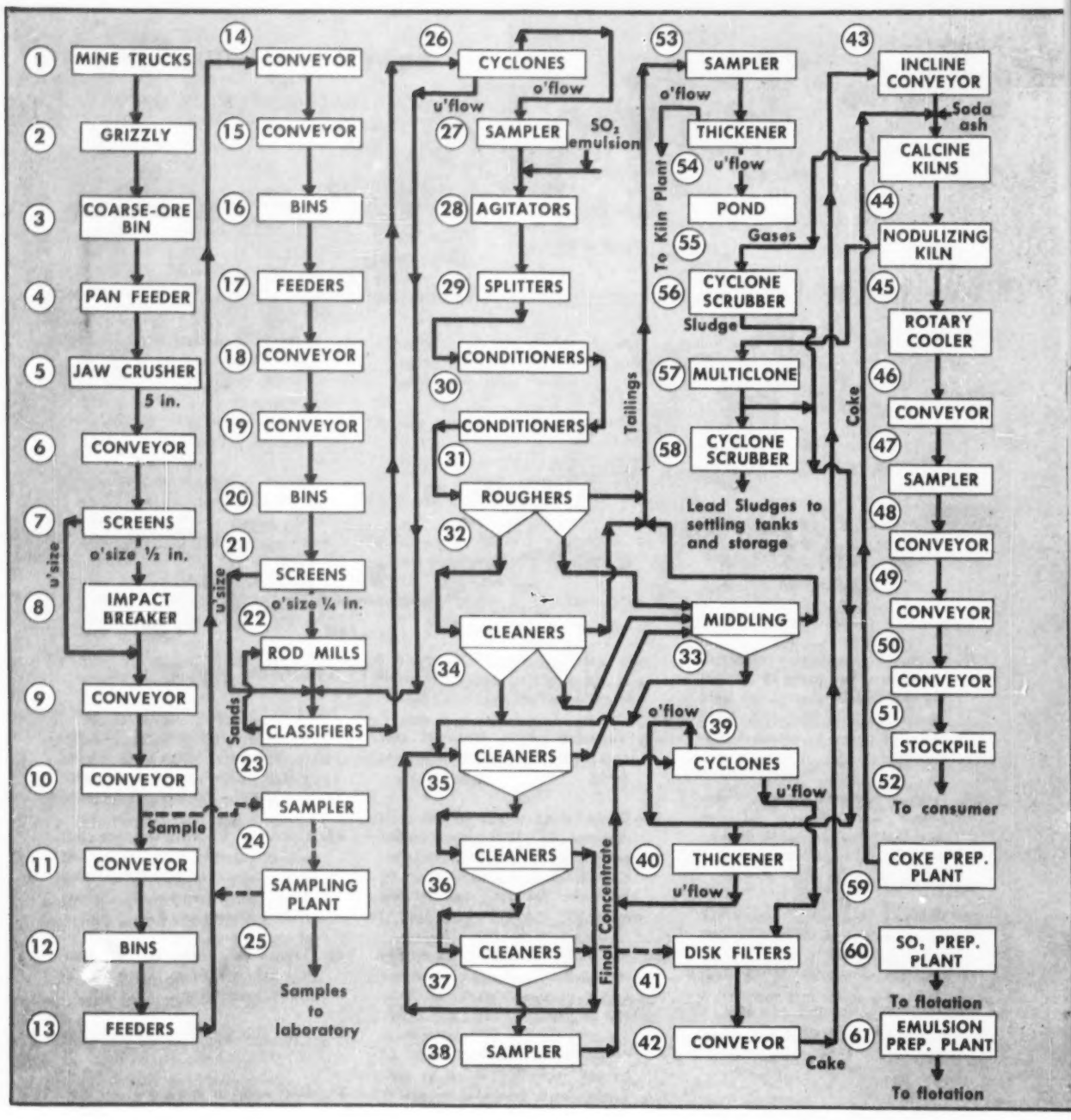
49. Tripper Conveyor D. Fifty-four-inch belt unit diverts pellets to bins or to storage area.

50. Bins. Five bins with 6,000-long ton capacity.

51. Boat loaders. Ten conveyors (2 to each bin) feed two boat loaders each containing a 60-in. conveyor with capacity of 3,000 long tons per hour.

52. Pellet storage bridge. Main span is 465 ft, cantilever span is 200 ft. Houses 42-in. Conveyor E with capacity of 1,550 long tons per hour.

53. Pellet storage area, 1.7-million long tons.



Manganese Inc. Uses Emulsion-Flotation on Three Kids Manganese Ore

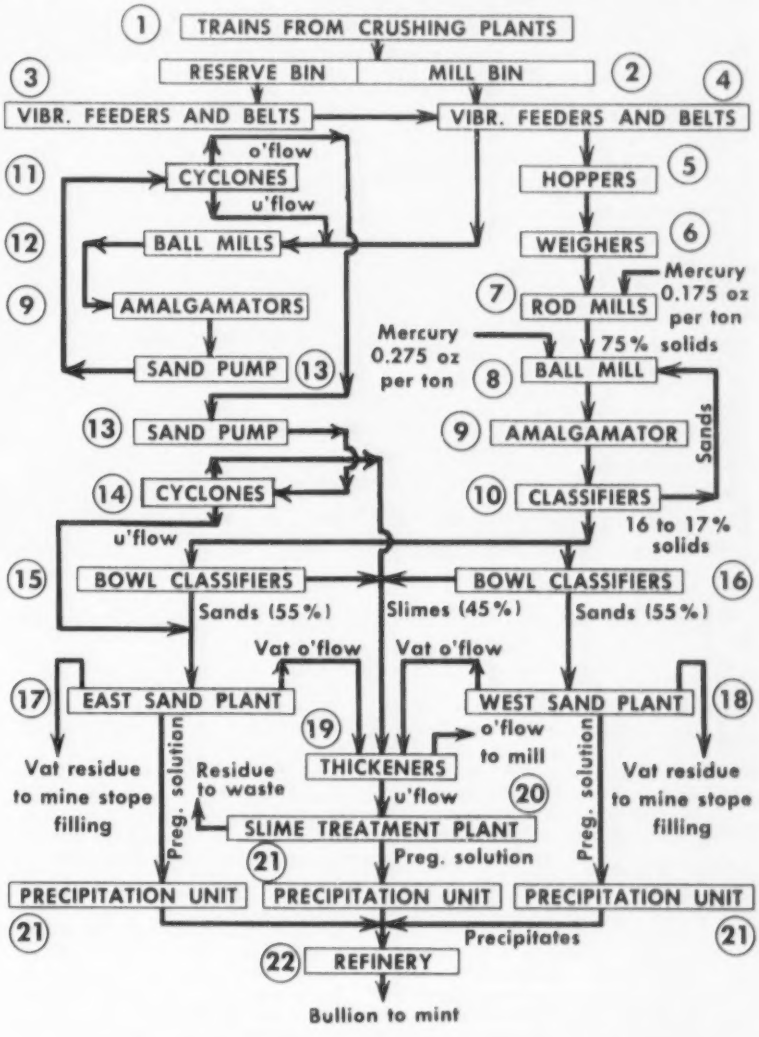
LEGEND

1. Euclid trucks from mine or blending piles
2. Steel grizzly, 24x30-in. openings
3. Coarse-ore bin, 50 tons live load
4. Pan feeder, 54 in. by 10 ft-2 in. S-A
5. Traylor Type H 30x42-in. jaw crusher
6. Belt conveyor, 30-in., with Stearns magnetic pulley
7. Symons 4x8-ft rod-deck screen, ½-in. openings
8. Cedar Rapids 30x30-in. impact breaker
9. Belt conveyor, 24-in.
10. Belt conveyor, 24-in., with Merrick Weightometer
11. Belt conveyor, 24-in., with S-A tripper
12. Blending bins, 1,400-ton capacity
13. Hardinge feeders
14. Belt conveyor, 20-in.
15. Belt conveyor, 20-in., with S-A tripper
16. Bedding bins, 360-ton capacity
17. Jeffrey roll feeders
18. Belt conveyor, 20-in.
19. Belt conveyors, 20-in., with S-A trippers

Homestake Mining Co. Amalgamates and Cyanides Gold

LEGEND *(Continued)*

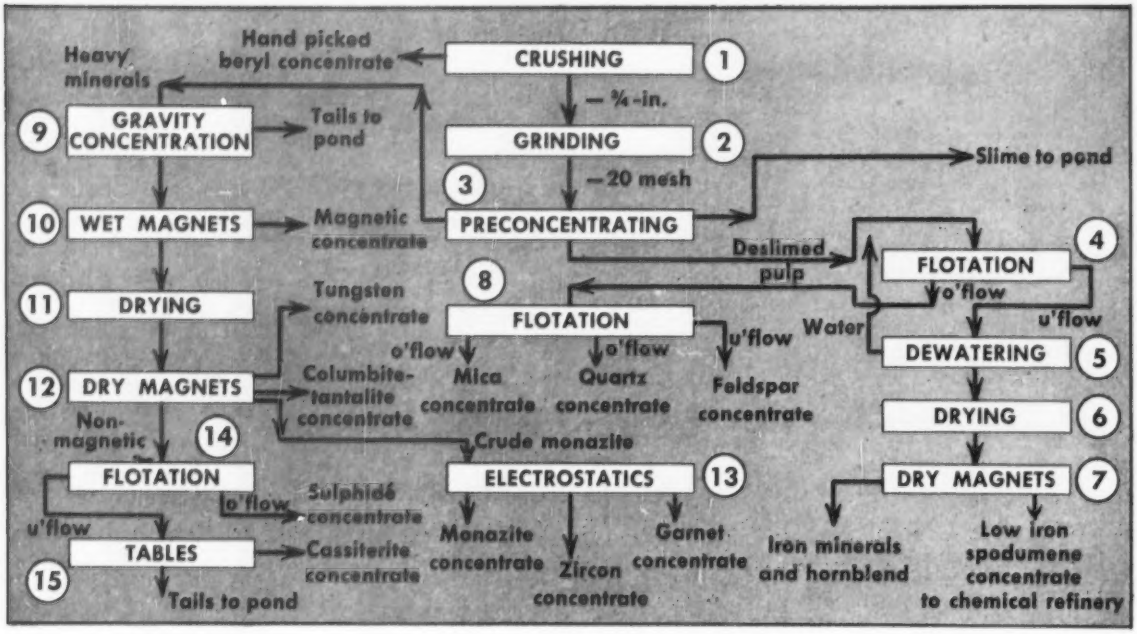
20. Two rod mill bins, 120-ton capacity each, equipped with Merrick 20-in. Feedoweights
21. Two Symons 3x6-ft rod-deck screens, ¼-in. openings
22. Two Marcy 7x10-ft rod mills
23. Two Akins 78-in. classifiers
24. One Geary-Jennings sampler
25. Sampling plant
26. Eight 12-in. cyclones, four per mill circuit
27. Two Geary-Jennings samplers, one per mill circuit
28. Two agitators, one per mill circuit
29. Two Splitter boxes, one per mill circuit
30. Four Wemco 66-in., 8-cell conditioners, two units per mill circuit
31. Two Wemco 66-in., 7-cell machines, 6 cells used as conditioners, one unit per mill circuit
32. Two Wemco 66-in., 7-cell roughers, one per mill circuit
33. Two Wemco 66-in., 4-cell middling machines, one per mill circuit
34. Two Wemco 66-in., 5-cell cleaners, one per mill circuit
35. Two Wemco 66-in., 4-cell cleaners, one per mill circuit
36. Two Wemco 66-in., 3-cell cleaners, one per mill circuit
37. Two Wemco 66-in., 3-cell cleaners, one per mill circuit
38. Two Geary-Jennings samplers
39. Eight 12-in. cyclones, two units ahead of each filter
40. Dorr traction thickener, 120-ft
41. Four 8½-ft, 10-leaf American, Oliver disk filters, two per mill circuit
42. Belt conveyor, 24-in.
43. Belt conveyor, 24-in., with Merrick Weightometer
44. Two calcine kilns, 8x150-ft
45. Nodulizing kiln, 10x150-ft
46. Rotary cooler, 8x96-ft
47. Pan conveyor, 18-in.
48. Denver nodule sampler
49. Belt conveyor, 18-in., with Merrick Weightometer
50. Belt conveyor, 18-in., with S-A tripper
51. Stacking conveyor, 18-in.
52. Stockpile area
53. Two Geary-Jennings tailings samplers, one per mill circuit
54. Dorr traction thickener, 165-ft
55. Storage pond
56. Cyclone dust scrubber for calcine kiln gases
57. Multiclone for nodulizing kiln gases
58. Two-stage cyclone scrubber for nodulizing kiln gases
59. Coke preparation plant
60. SO_2 preparation plant
61. Emulsion preparation plant



Mill, Sand and Slime Treatment Plants

LEGEND

1. Trains made up of thirty 5-ton from Yates and Ross shaft crushing plants
2. 3500-ton mill bin and 1500-ton reserve ore bin
3. Eight 24x48-in. Jeffrey-Traylor vibrating feeders and 24-in. belt conveyor to mill ore bin
4. Twelve 24x48 in. Jeffrey-Traylor vibrating feeders and three 24-in. belt conveyors discharging into hoppers ahead of Transportoweighers
5. Hoppers
6. Four transportoweighers
7. Three 6x12-ft Marcy rod mills
8. Three A-C 9x11-ft ball mills
9. Four Clark-Todd amalgamators
10. Three Dorr-type HX classifiers
11. Two D20 Krebs cyclones
12. 9x11-ft A-C ball mill
13. Two 8-in. Centriseal sand pumps
14. Two D20B Krebs cyclones
15. Four Dorr 6x33-ft 4-in. x 20-ft dia bowl classifiers. East Sand Plant
16. Two Dorr 6x33-ft 4-in. x 20-ft dia bowl classifiers and one 6-ft x 31-ft 8-in. x 16-ft dia bowl classifier, a Dorr stand-by unit. West Sand Plant
17. East Sand Plant. Twenty-one 44x11½-ft sand leaching vats, capacity 655 tons per vat per charge
18. West Sand Plant. Eight 44x12-ft sand leaching vats, capacity 725 tons per vat charge
19. Dorr thickeners
20. Slime treatment plant. Thirty-one Merrill slime presses, capacity 27 tons of solids per press per charge
21. Merrill-Crowe precipitation units
22. Refinery



Almost Anything Can Be Recovered From a Pegmatite — Nature's Garbage Can

This flowsheet is designed from the combined flowsheets of those companies beneficiating pegmatite ores for the minerals contained. No pegmatites will contain all of these minerals shown in the flowsheet. Flowsheet will have to be designed with the knowledge of values contained.

1. Crushing to minus ¾-in. is done by jaw crusher or cone crusher. If beryl is present it is best to attempt to hand pick ahead of the crusher. At present time no economical method for flotation recovery of beryl from a spodumene flowsheet is known. Open circuit grinding is reported as satisfactory, but closed circuit will produce less fines. Screens and grizzlies needed to control sizing

2. Grinding in rod mill more satisfactory than in ball mill. Screens to return plus 20 mesh oversize to mill

3. Preconcentration to remove slimes, to concentrate heavies for gravity separation and to prepare a spodumene flotation feed will depend upon the minerals present in the ore. Desliming is necessary ahead of flotation.

A. Humphrey spirals can be used to prepare a heavies concentrate, but tabular crystals of spodumene tend to report in the heavies

B. Screens have been used where a separation of coarse and fine sizes also makes a separation between spodumene and heavies or spodumene and coarse gangue

C. Jigs have been used to concentrate heavies

D. Tables have been used to concentrate heavies and/or to deslime. Where jigs and tables are used, it is necessary to classify feed by hydroclassification methods

LEGEND

E. Sand classifiers have been used to deslime and to thicken pulp ahead of flotation

F. Heavy media has been used to make heavies separation. It is possible to concentrate some beryl with the heavies. Spodumene can be deslimed as underflow with mica, quartz and feldspar in overflow

G. Wet cyclones have been used to deslime ahead of flotation. Some difficulties have been encountered in abrasion wear on cyclone orifice. Proper rubber-lined cyclones seem advantageous. Change in orifice through wear will change characteristic of separation. Attrition or scrubbing cells have been used in conjunction with cyclones to deslime loamy ore

H. Flotation, after 70% pulp density conditioning with reagents, has been used as a desliming stage. Soap has been used as collector of slimes. Cationic collectors have been used. Amines with alcohol collector have been suggested. Glue or starch used to depress spodumene at pH 10-11. Pulp density of feed should be 25-30% solids. Aluminum nitrate will depress spodumene. High pH keeps spodumene and iron minerals in underflow with some mica, quartz and feldspar in slime overflow. Lepidolyte, zinnwaldite, amblygonite and some beryl will tend to go in overflow. One producer is considering going back to this method to replace cyclones

4. Deslimed pulp, containing spodumene, silicates and iron minerals, is conditioned at about 70% pulp density with HF, H_2SO_4 and amine resinate collector. Pine oil can be used as frother. Mica, quartz and feldspar report in overflow. Iron minerals, hornblend and spodumene stay in underflow at pH less than 5. Pulp density at feed cell should be 25-30% solids

5. Sand classifier and filter to dewater. Return water to flotation

6. Direct fired rotary drier

7. Electro magnetic separators to remove hornblend and iron minerals. Iron free concentrate of spodumene shipped to chemical refinery

8. Flotation treatment of overflow from spodumene flotation can be made to prepare a mica concentrate, a quartz concentrate and a feldspar (underflow) concentrate by HF flotation methods

9. Jigs and/or tables have been used to produce heavies concentrate from ore. Pegmatites may contain cassiterite, columbite, magnetite, tantalite, monazite, zircon, garnet, sulphides and tungsten-bearing minerals. Minerals present in ore will determine mill design

10. Wet magnetic separators produce a magnetic concentrate and a weakly magnetic feed to the drier

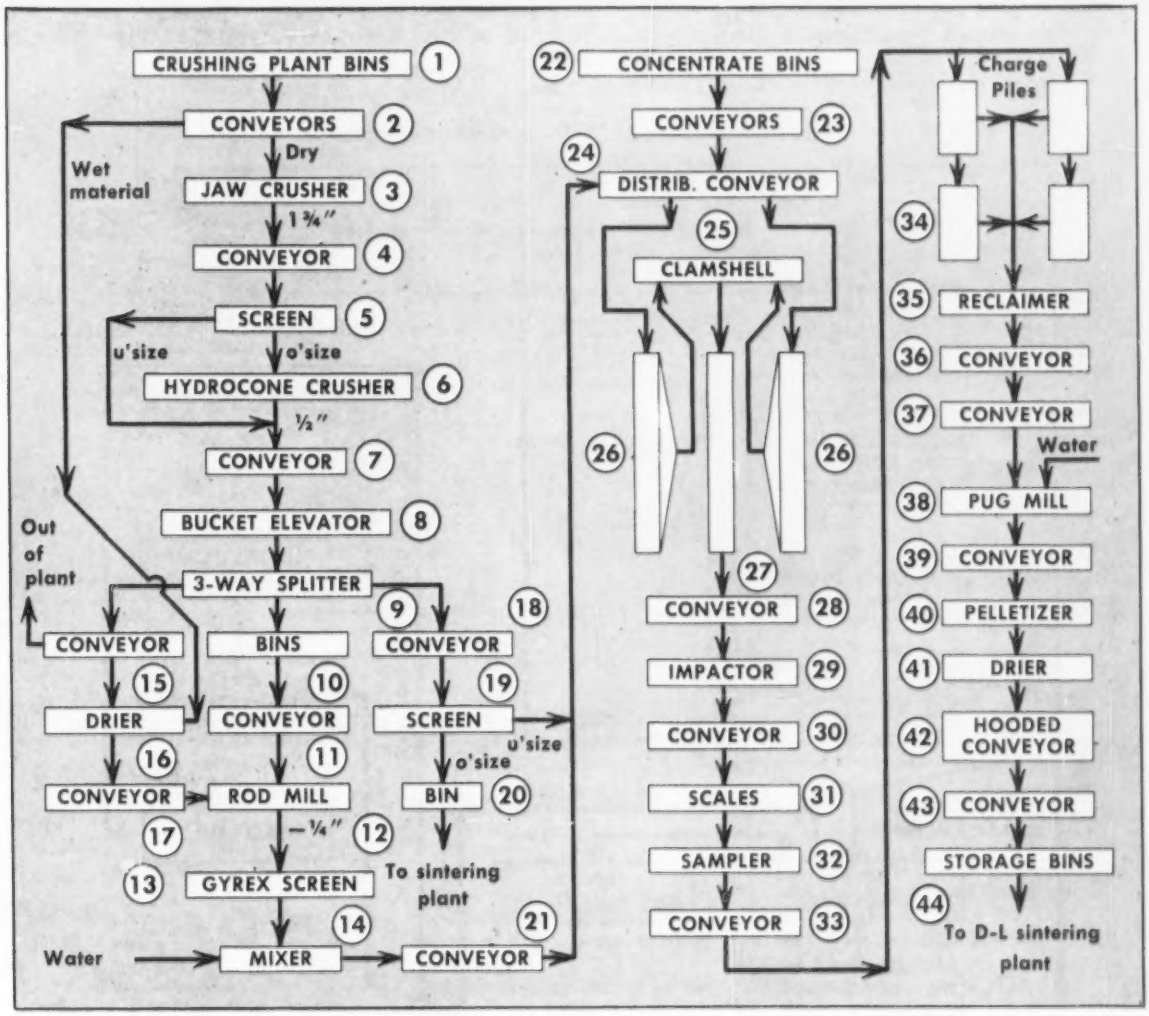
11. Dewatering or filtering necessary ahead of the drier

12. Electromagnets produce a tunsten concentrate and/or columbite-tantalite concentrate, a non-magnetic flotation feed and/or a crude monazite concentrate

13. Electrostatic separators prepare concentrates such as monazite, zircon and garnet

14. Xanthate flotation of non-magnetic tails produces sulphide concentrate with flotation tails going to tables

15. Table concentrates cassiterite mineral and tails go to pond



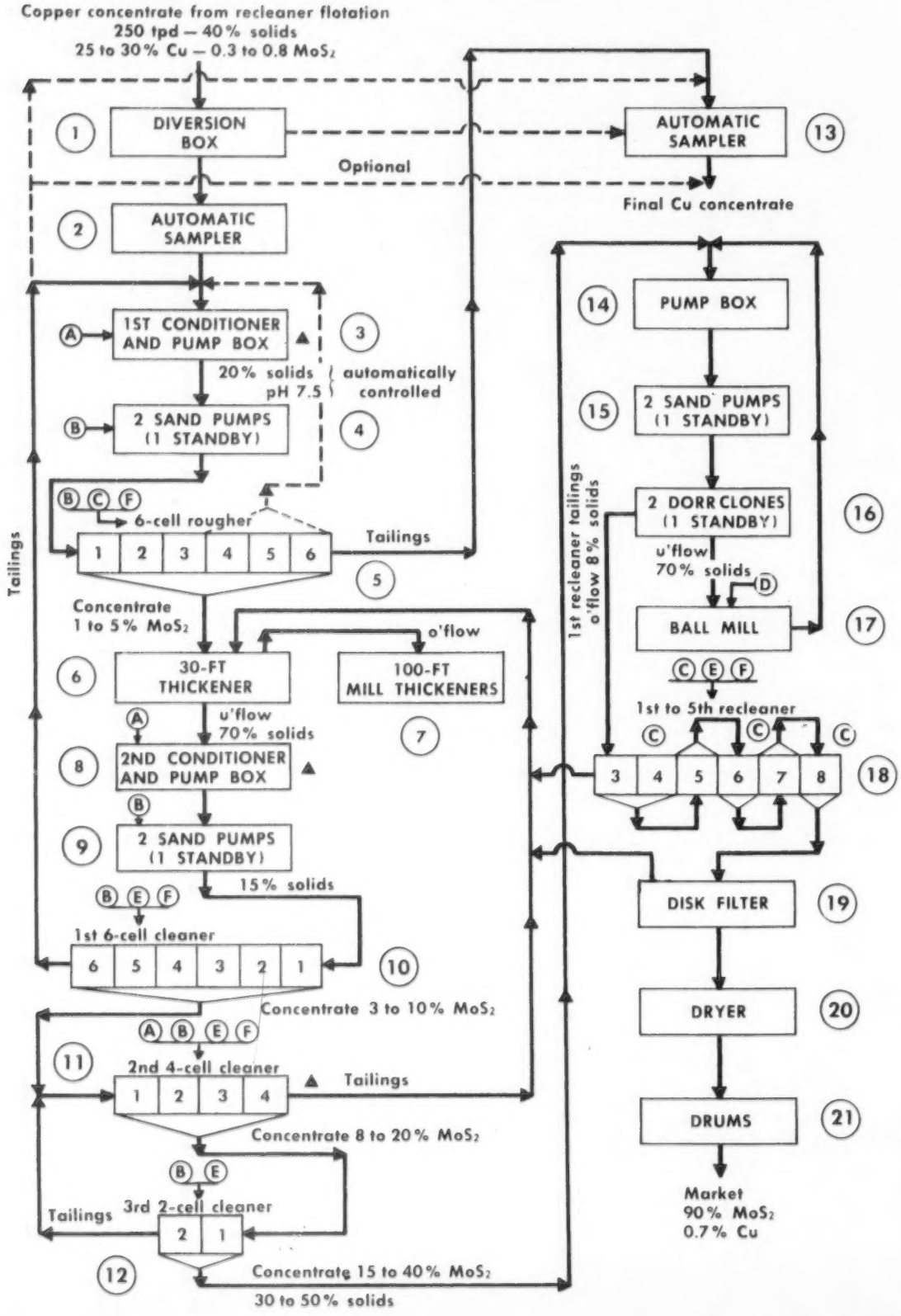
Bunker Hill Co. Improved Kellogg's Lead Sinter By Blending Concentrate and Flux

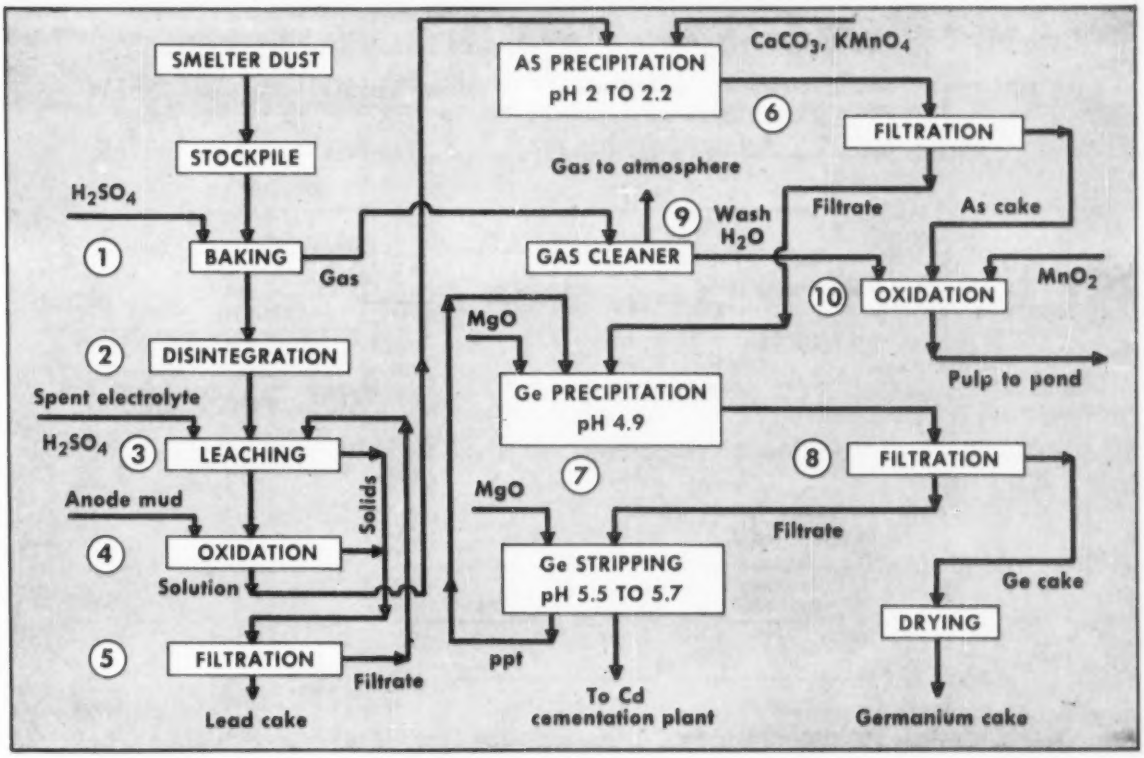
LEGEND

1. Bins for coarse wet and dry material
2. Belt conveyor system, Hewitt-Robins 30-in. and 24-in. belts
3. Traylor 24x36-in. jaw crusher
4. 24-in. H-R belt conveyor*
5. Allis-Chalmers 4x8-ft. rod deck screen, 1¾-in. openings
6. Allis-Chalmers No. 648 Hydrocone crusher
7. 16-in. H-R belt conveyor
8. Jeffrey bucket elevator, 77 ft. high
9. 3-way splitter
10. Two 12x17½-ft. circular steel storage bins
11. 16-in. H-R conveyor
12. Allis-Chalmers 9x12 rod mill
13. Robins Gyrex Screen, one mesh
14. Jeffrey double paddle mixer
15. 16-in. H-R reversible belt conveyor
16. 8x60-ft. Stearns-Roger rotary drier
17. 24-in. H-R belt conveyor
18. 16-in. H-R belt conveyor
19. 4x8-ft. Symons Roddeck screen ¼ in., for sinter
20. Sinter pallet dressing storage bin
21. 16-in. H-R belt conveyor
22. Bins for concentrates and fine materials
23. Belt conveyor system, 30-in. and 24-in. belts
24. 16-in. H-R distribution belt with trippers
25. P&H overhead crane with 2-yd. Blaw-Knox clamshell bucket
26. 11 concrete storage bins for crushing plant products
    8 concrete bins for concentrates and fines
27. 19 steel hopper-bottom proportioning bins
28. Belt conveyor system with 30-in. H-R belts
29. Pennsylvania reversible crusher
30. Belt conveyor system with 30-in. H-R belts
31. Merrick Weightometer and Rateograph
32. Bucket sampler
33. 24-in. H-R belt conveyor
34. Four 900-ton piles
35. Mechanical reclaimer
36. 30-in. H-R belt conveyor, gathering belt
37. 24-in. H-R belt conveyor
38. American Ore Reduction pug mill
39. 24-in. H-R belt conveyor
40. 8x15-ft. Stearns-Roger pelletizing drum
41. 7x30-ft. Stearns-Roger rotary drier
42. Two H-R 30-in. belt conveyors
43. 24-in. H-R belt conveyor
44. Two 350-ton pellet storage bins

*All belt conveyors are Hewitt-Robins and labeled H-R here

American Smelting & Refining Co. Added a Molybdenite Circuit at Silver Bell





Union Miniere du Haut-Katanga Cleans Germanium From Smelter Gases

LEGEND

1. Baking is done in 3½-ft diameter by 72-ft long rotary kiln; 6-in. acid proof brick lining. 450 to 500 deg C for 4 hr
2. Baked material is disintegrated in hammer mill
3. Leaching accomplished in 1500 cu ft lead lined agitators 20,000 to 22,000 lb batches at 2½ to 1 pulp density, 1½ hr
4. Solution from leach is oxidized by agitating with MnO_2 anode mud and $KMnO_4$ in 1500 cu ft tanks for 1½ hr at 45 deg C
5. Settled solids are filtered on two presses for recovery of lead cake
6. Arsenic is precipitated by adding crushed limestone and precipitate is removed on two filter presses
7. Addition of MgO precipitates copper hydroxide which carries germanium with it. Low grade precipitate is returned to circuit
8. High grade Ge precipitate is filtered and dried on Lowden drier
9. Waste gas from kiln is cleaned in Anthony Venturi scrubber
10. Water from scrubber is combined with arsenic cake, oxidized with MnO_2 ore in two pachuca tanks at 45 to 50 deg C, and pumped to tailing pond

Silver Bell's By-Product Is a 90% Molybdenite Concentrate

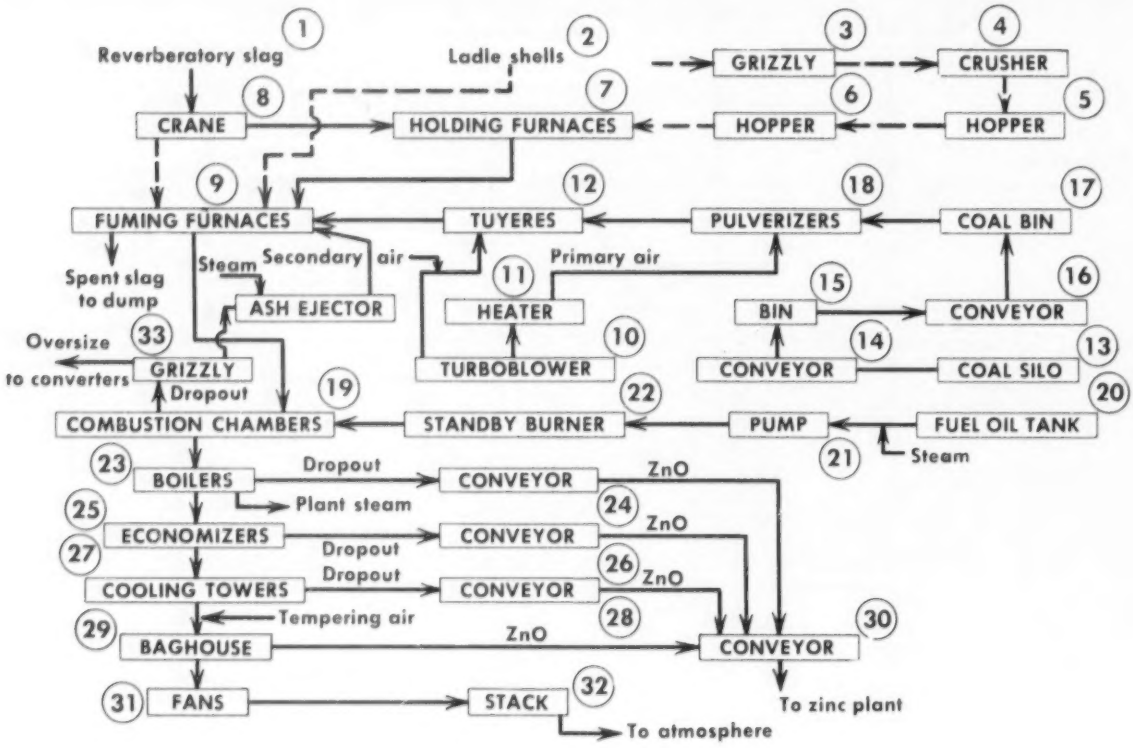
LEGEND

1. Diversion box
2. Automatic sampler
3. Conditioner and pump box
4. Two sand pumps (1 standby)
5. No. 24 Denver 6-cell rougher
6. 30-ft thickener
7. 100-ft thickeners located in the main copper concentrator section collect overflow from 30-ft thickener (6). Underflow from 100-ft thickeners is need for the regular copper circuit cleaner flotation section. There are no tailings going to the dump from the moly plant.
8. Conditioner and pump box
9. Two sand pumps (1 standby)
10. No. 18 Denver 6-cell first cleaner
11. No. 12 Denver 4-cell second cleaner
12. No. 12 Denver 2-cell third cleaner
13. Automatic sampler
14. Pump box
15. Two sand pumps (1 standby)
16. Two 3-in. DorrClones (1 standby)
17. Marcy No. 34 ball mill
18. No. 12 Denver 6-cell recleaner
19. Disk filter
20. Dryer
21. Steel shipping drums

REAGENT SYMBOLS

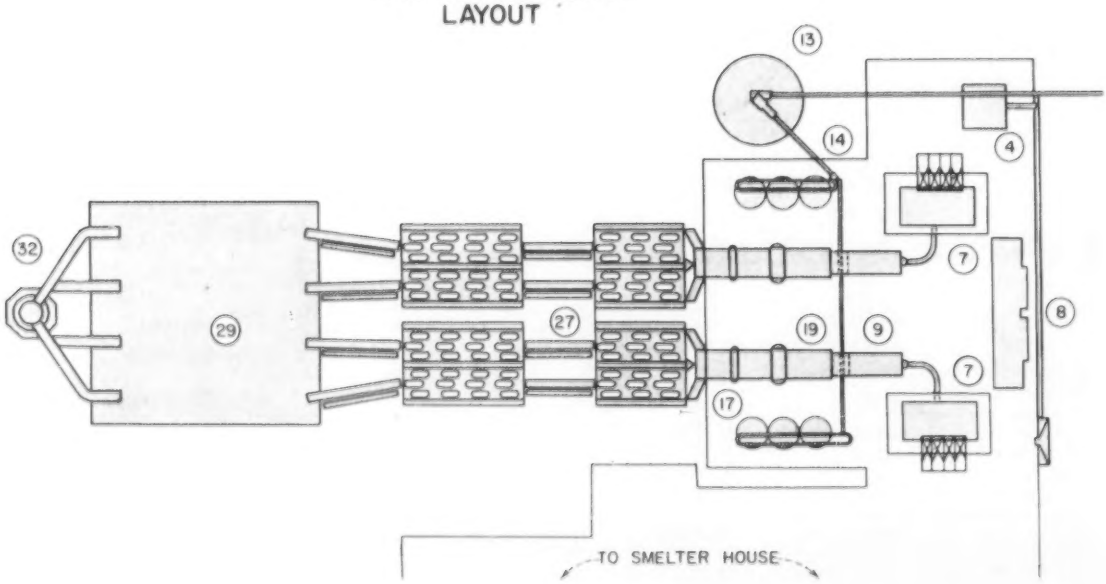
B Na_2SO_4
B $Na_4Fe(CN)_6$
C NaCN
D Na_2SiO_3
E Frother
F Oronite and diesel oil

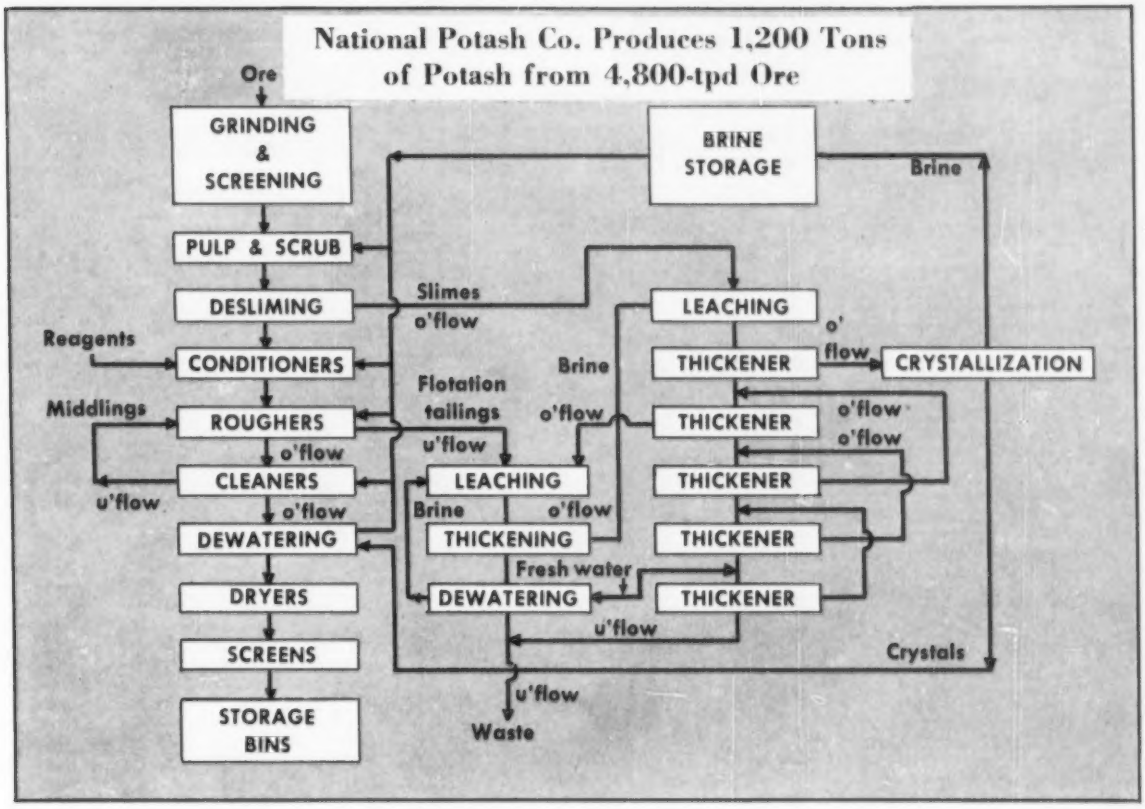
Arrow indicates points at which pH is controlled automatically



Hudson Bay Mining & Smelting Co. Ltd. Fumes Some 640,000 Tons of Copper

HUDSON BAY MINING & SMELTING CO., LTD.
FLIN FLON, MANITOBA
ZINC FUMING PLANT
LAYOUT

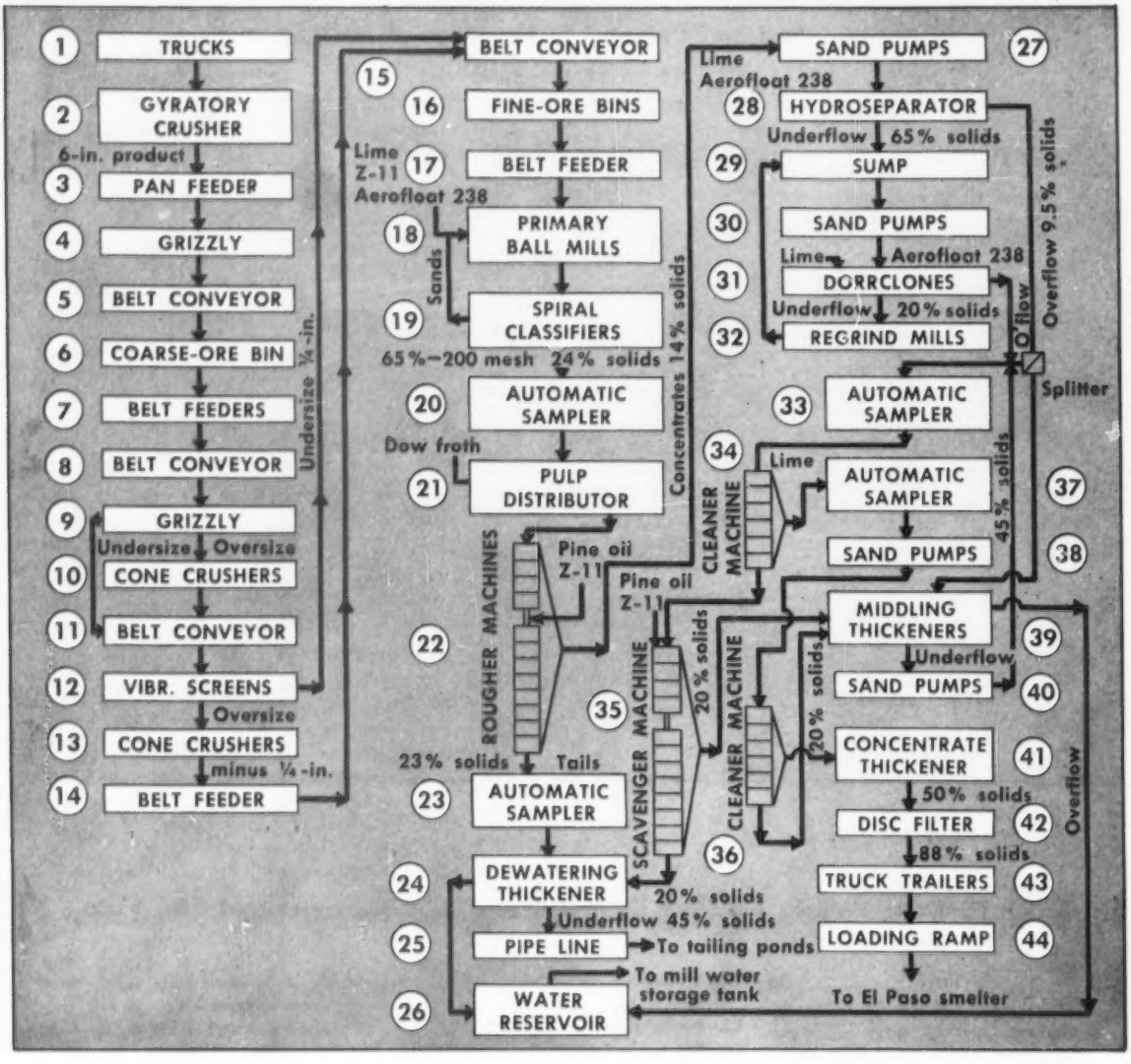




Reverb Slag Each Year to Recover 34,000 Tons of Zinc-in-Fume at Flin Flon

LEGEND

1. Reverberatory slag runs approximately: Au—0.004 oz, Ag—0.114 oz, Cu—0.44%, Zn—8.17%, Pb—0.23%, SiO_2—34.7%, Fe—31%, Al_2O_3—5.4%, MgO—2.8%, CaO—1.6% and S—1.8%
2. Ladles are shelled on each trip and shells charged to fuming furnaces. If too heavy they are crushed and sent to holding furnaces
3. Grizzly ahead of the crusher
4. Traylor gyratory crusher, 12-in.
5. Crushed slag hopper
6. Holding furnace hopper
7. Two, 2,000-kva Lectromelt furnaces, one to each fuming furnace. Matte is tapped periodically and sent back to converters
8. Two 40-ton Provincial cranes for ladle service
9. Two 8x21-ft fuming furnaces, coal-fired. Take 74-ton charge
10. Three Turbo blowers, one to each fuming furnace and one on standby. Blowers delivers 10,000 cfm at 12.5 psi, have 700-hp electric motor. Gyrol fluid coupling and speed increaser permit blowers to turn over at maximum 8,400 rpm
11. Preheater for primary air
12. Each fuming furnace has 21 tuyeres to each side
13. Fuming plant raw coal storage bin
14. Belt conveyor to coal bin at fuming plant
15. Coal bin, 700-ton capacity
16. Redler elevator and Redler run-around conveyor
17. Three pulverizer coal bins to each fumin furnace. Bins are air-tight and under 12.5 psi
18. Three Babcock & Wilcox Type E-29 pulverizers, one to each furnace. They grind coal to 90% minus 200 mesh with third on standby
19. Combustion chambers, where oxidation of the zinc is completed. Heavy particles that settle out are collected in hopper for return to fuming furnace by steam injector
20. Standby burner fuel oil tank
21. Oil pump
22. Standby burners for combustion chambers
23. Waste heat boilers to produce 400-psi steam for plant use
24. Screw conveyor takes settled oxide from boiler to oxide conveyor 30
25. Economizers to preheat feed water for boilers
26. Screw conveyor takes settled oxide to oxide conveyor 30
27. Cooling towers of 38-in. dia U-tubes, air cooled
28. Screw conveyor takes settled oxide to oxide conveyor 30
29. Northern Blower baghouse with eight arresters arranged in pairs lengthwise over a balloon hopper. Bags are 6-in. dia by 99-in. long with about 12 sq ft cloth area. Total cloth area 104,832 sq ft. Average gas flow is 134,000 cfm at 200 deg F. Maximum temperature permitted with mixed Dacron and Orlon is 250 deg F. Efficiency is better than 99%
30. Oxide conveyor delivers oxide collected in boilers, economizers, cooling tubes and baghouse to the zinc plant where oxide is recovered as slab zinc
31. Two No. 70 Northern Blower draft fans maintain furnace draft on each unit. Capacity to deliver 38,000 cfm at 200 deg F and 9-in. water pressure
32. Flue stack is 10x65-ft steel construction, vents cleaned effluent to atmosphere
33. Dropout from combustion chamber worked through 2-in. grizzley and returned to fuming furnace via steam injector

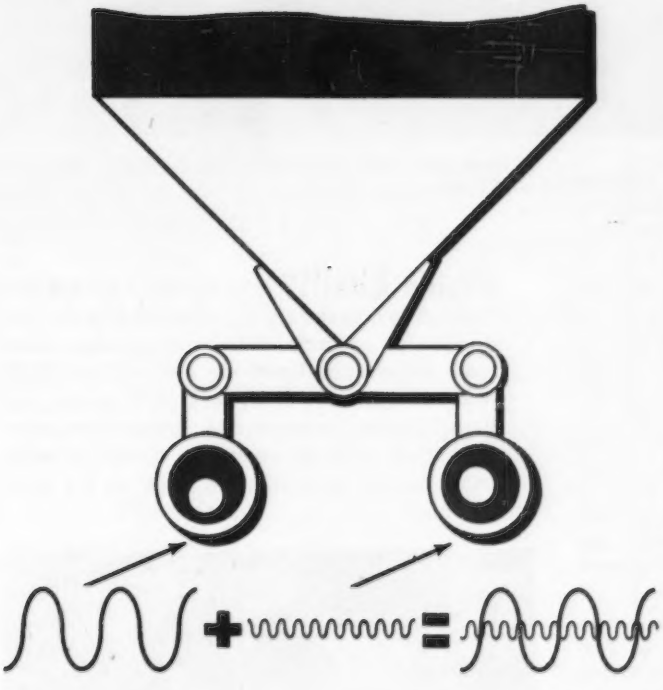


AS&R Designed Silver Bell to Concentrate 7,500 Tons of Copper Ore Daily

1. Euclid FF trucks (37-ton cap.) from pits
2. Traylor 48-in. gyratory crusher, set 6 in.
3. S-A 72-in. pan feeder
4. Chute with built-in grizzly
5. 48-in. belt conveyor with magnetic detector
6. 3000-ton circular steel coarse-ore bin
7. Two 48-in. belt feeders
8. 42-in. belt conveyor with suspended magnet
9. Chute with built-in grizzly
10. 7-ft Symons secondary cone crusher set 1¼ in.
11. 36-in. belt conveyor
12. Four 6x10ft Tyrock vibrating screens (½-in. square openings)
13. Two 7-ft Symons tertiary cone crushers, set ¼ in.
14. Two 36-in. belt feeders
15. 36-in. belt conveyor with Weightometer
16. Four 2000-ton fine ore bins, circular, steel construction
17. Four belt feeders and Weightometers
18. Four A-C 10½x12-ft primary ball mills driven by 900-hp motors at 18.4 rpm, 3- and 2-in. balls used.
19. Four 85-in. Akins screw classifiers.
20. Automatic sampler
21. Pulp distributor
22. Eight Wemco Fagergren rougher units made up of 4-cell and 8-cell machines in series (two units to each mill circuit)
23. Automatic sampler
24. Dorr 275-ft dewatering thickener
25. Transite pipe line system to tailings ponds
26. 1-million-gal water reservoir
27. Six Hydroseal sand pumps (two standby)
28. Dorr 30-ft Hydroseparator
29. Sump
30. Four Hydroseal sand pumps
31. Four DorrClones
32. Two 7x12-ft A-C regrind mills
33. Automatic sampler
34. Two Wemco Fagergren 6-cell cleaner machines
35. Scavenger machine made up of 4-cell and 8-cell in series Wemco Fagergren units
36. Denver 6-cell cleaner machine
37. Automatic Sampler
38. Three Hydroseal sand pumps (one standby)
39. Two 100-ft Dorr middlings thickeners
40. Three Hydroseal sand pumps (one standby)
41. Dorr 60-ft final concentrate thickener
42. Oliver 6-ft disc filter
43. 20-ton Kenworth-Fruehauf truck-trailer units
44. Loading ramp at railroad

In this [illegible] for Fine [illegible] eficiation

it's th EXTRA JIGGLE that counts!



The Wemco-Remer Jig provides:

- Better Stratification
- Uniformity of Jigging Action
- Accelerated Settling of Heavy Fines
- Faster Hutching of Fine Concentrates
- Greater Capacity
- Maximum Efficiency
- Freedom from Sanding or Dead Spots

Because of these factors, you are able to treat size ranges never before efficiently jigged . . . with concentration even in the finest sizes.

These Jigs have been repeatedly chosen after competitive tests and complete evaluations to determine the most economic means to concentrate the minus ¼" portion of feed in Iron Ore Heavy Media plants.

Before deciding on your fine ore treatment method, investigate what Wemco-Remer Jigs are doing for others.

With other Jigs, there is only one stroke. It's the Extra Jiggle in the Wemco-Remer Jig that makes the difference. For more details, send for free bulletin J2-B3.

Representatives in principal cities in United States and Canada and in major countries throughout the world.

WEMCO®

WESTERN MACHINERY COMPANY

650 FIFTH STREET, SAN FRANCISCO 7, CALIFORNIA

VERSATILE BUCYRUS-ERIE STRIPPER WITH THE RIGHT CAPACITY AND REACH

A Bucyrus-Erie 88-B shovel strips overburden at a Minnesota iron mine. The machine is owned by the S. J. Groves Co., Minneapolis.

Whether your stripping operation requires a dragline, stripping shovel or a standard shovel, the Bucyrus-Erie 88-B offers the flexibility to do the job to your satisfaction.

With either of these three front ends, the 88-B puts more than 75 years of Bucyrus-Erie know-how on your job. It is a dependable, *basic* excavator — designed to function efficiently with whichever front end best fits your needs.

The 88-B's big diesel power plant, with your choice of torque converter or direct drive, provides plenty of power for the toughest digging and transmits it with high efficiency through the anti-friction bearings to the point of use. Its smooth, soft air controls permit easy, fast operation while retaining the "feel" of control for the operator.

This outstanding stripping specialist is rated at 2 to 5 cubic yards as a dragline, 3 cubic yards as a stripping shovel and 4 cubic yards as a standard shovel. Take your choice and be secure with the knowledge that your stripper comes equipped with Bucyrus-Erie mining know-how.

369E57

BUCYRUS ERIE

SOUTH MILWAUKEE
WISCONSIN

Bonus Quality Specifications for molding and core sands are rigidly adhered to in the production of castings. Sand compositions must meet close specifications for permeability, moisture content, compression strength, and high-temperature properties. Here, a laboratory technician uses an electronic meter to determine the PH (acid-alkaline ratio) of the sand mixture.

Mineral Exploration in Maine Is Expanding

REPRESENTATIVES of mining firms, now exploring for minerals in Maine, are spending over half a million dollars this year while total product sales of these companies exceed $2.5-billion.

This announcement came from John R. Rand, State Geologist, in the Department of Economic Development. He went on to say that the Federal Government and State Geological Survey are also undertaking mineral exploration projects, though not spending nearly as much as are the private firms.

Exploration is chiefly for copper, nickel, lead and zinc while, on a smaller scale, for limestone, lithium minerals, slate, beryl, quartz sand, and feldspar.

ARTIFICIAL INDUSTRIAL DIAMONDS (shown here—$30,000 worth) are about to be produced in large quantities, according to the General Electric Co.'s Metallurgical products Department. G. E. also reported that more than 100,000 carats, equal in performance to those produced by nature, have already been produced at its pilot-plant operations in Detroit.

Kaiser Makes First Pour

INITIAL reduction of primary aluminum metal from the Kaiser Aluminum & Chemical Corp.'s Ravenswood, W. Va. plant took place in late November. The pour marked the first production from alumina of the $200-million facility, which has a primary metal capacity of 145,000 tons per year. Plant will also produce some 170,000 tons of rolled products annually.

Rem-Cru Acquired

CRUCIBLE STEEL CO., one of the co-owners of Rem-Cru Titanium, Inc., has taken full ownership through purchase from Remington Arms Co. Payment was made in the common stock of the steel company.

for Maximum Efficiency and Economy in all classes of separation and Concentration

• In heavy-media separation, Dings Wet Drum Magnetic Separators assure maximum recovery of magnetite and ferrosilicon . . . up to 99.8%.

In direct concentration service, selective separation possible with Dings design assures rejection of high tonnages of low iron non-magnetics in rod or ball mill cobber positions and consistently high grade silica-free concentrates from finisher separators.

Whatever your separation or concentration problem, over 50 years of specialized experience, backed by actual field trial where required, is available to assist you in selecting the best type of separator to solve your specific needs.

DINGS MAGNETIC SEPARATOR CO.
4716 W. Electric Ave., Milwaukee 46, Wis.

For further details, send for Bulletin B-1500.

Dings

DINGS MAGNETIC SEPARATOR CO.
4716 W. Electric Ave.
Milwaukee 46, Wis.

Please send copy of Bulletin B-1500.

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Company_____

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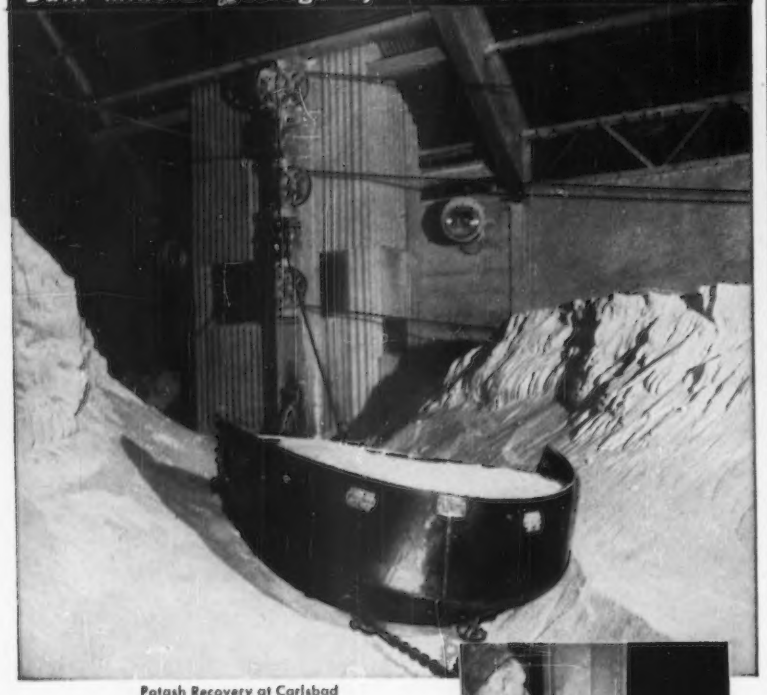
City_____ Zone_____ State_____

WC155-2/3

Bulk Mineral Storage by the SAUERMAN Method



Potash Recovery at Carlsbad

How Sauerman Scraper Storage Reduces Costs

Remote Control

This prominent producer of basic chemicals uses Sauerman 1½-cu. yd. Drag Scraper Machines to reclaim potash at 200 tph. Total area covered is approximately 125 by 370 ft. Building capacity is 60,000 tons.

Here's how a Sauerman Machine cuts costs:

One operator, located in a safe station, overseeing the entire area, can recover practically 100% of all stockpiled material.

All highly machined parts, hoists and motors can be located outside of the building and protected from corrosion and dust.

When parts are replaced—sheaves, clutch or brake linings—the machine is restored to practically new condition, even though it may be twenty or more years old.

Only the Crescent scraper and cables contact the material. The scraper machine can be designed to operate the scraper on top of non-caving material. This allows the scraper to break down any high faces that may be standing.

Sauerman Storage Machines are built for hourly capacities of from 20 to 600 cu. yds. A partial list of producers and manufacturers using some type of Sauerman equipment includes:

Crawford Chemical Co.
Davison Chemical Co. Division of W. R. Grace & Co.
Duval Sulphur & Potash Co.
F. S. Royster Guano Co.
International Minerals & Chemical Corp.
Lion Oil Co.
Potash Company of America
Red Star Fertilizer Co.
Southern Agricultural Fertilizer Co.
Tennessee Farmers Cooperative
Virginia-Carolina Chemical Corp.

For ways to reduce your material handling costs, request Catalog E, *Bulk Storage by Scraper*, plus Field Report 227 and other reports on the handling of your material by Sauerman Machines.

SAUERMAN BROS. INC.

626 S. 28TH AVE. BELLWOOD, ILL.

Casa Buys Huge Tract Of Argentine Ore Land

THREE THOUSAND five hundred and ninety-four square miles of land containing silver, lead-zinc, iron ore, graphite, salt and coal have been purchased by Coney Argentina S. A. (Casa) in Argentina's Mendoza Province, according to the engineering firm of C. E. Bradberry & Assoc., Los Altos, Calif.

Coney

Casa's property is also reported to have a small producing oil field plus deposits of gilsonite and asphalt. Argentina's government is completing work on the Nihuil dam and hydroelectric plant which, when finished, will provide power for the immediate area.

J. J. Coney, head of Casa, is presently developing an extensive deposit of perlite on Sonoma County property owned by the Hillcone Steamship Co., which he also directs.

Mangula Begins Output

SOUTHERN RHODESIA'S new $12-million copper mine, Mangula, 100 miles northwest of Salisbury, came into production in November, fifteen months ahead of schedule.

The mine is producing copper concentrate—approximately 50% copper—and its output target is 10,000 tons of concentrates a year. At first the concentrates will be exported without further treatment but later the mine plans to build its own smelter.

Aluminium Ltd. Cancels Latest Expansion Program

A DIRECT RESULT of Aluminium Ltd.'s cancellation of proposed expansions was a postponement of plans to add 80,000 tons of ingot capacity to the present 180,000 tons at Kitimat, B. C., operations of its subsidiary, Aluminum Co. of Canada.

However, Nathanael V. Davis, Aluminium Ltd.'s president, said that the deferment decision "leaves basically unaffected the company's program for the development of new hydroelectric and raw material facilities, upon which future ingot expansion will be based."

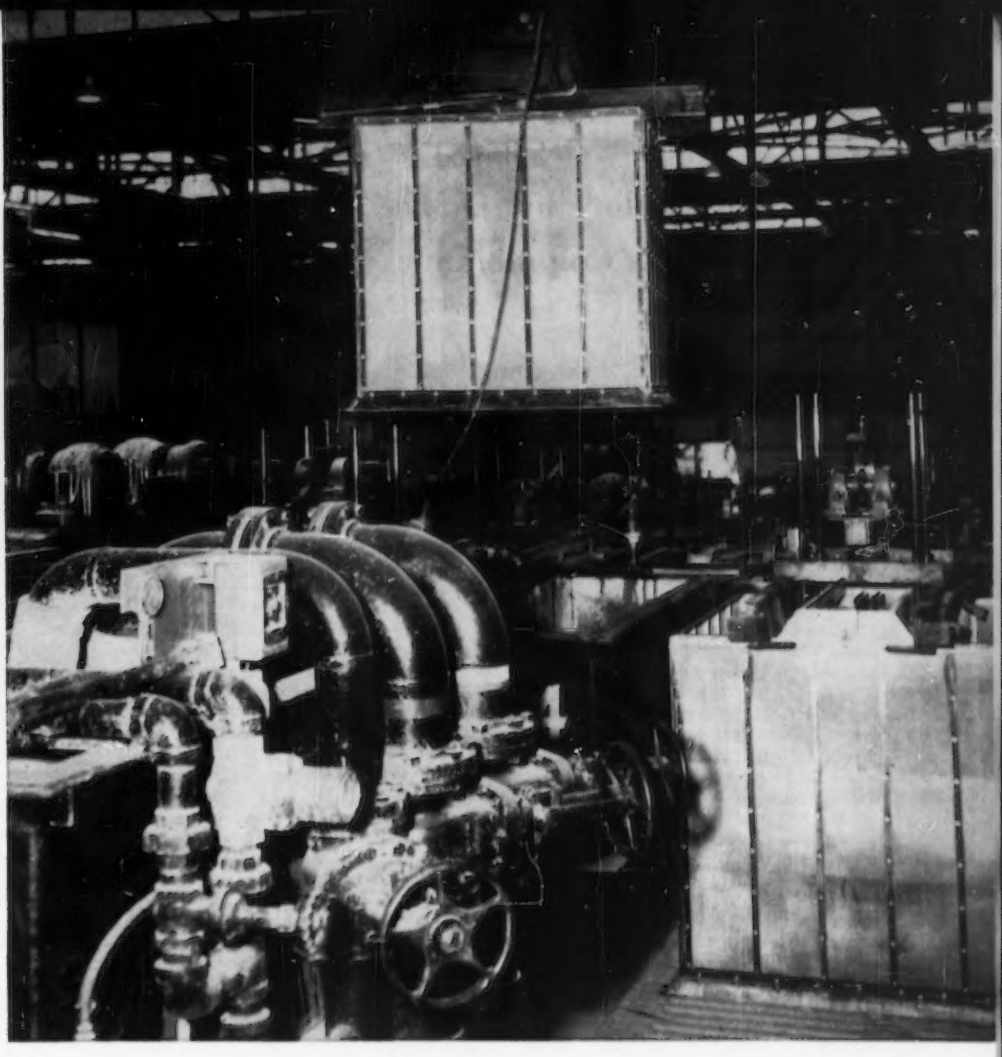
IN THE U. S.

ALASKA

Disposition of the only tin mine in North America apparently will be the problem of the General Services Administration, as the result of a public auction Oct. 30 at Lost River, Alaska, 100 miles northwest of Nome.

The Federal agency submitted a bid in the same amount as a Government

Stainless Steel valves and piping at acid storage tanks.



Stainless Steel baskets containing ion exchange resins. Adhering sulfate ions are stripped with ammonium nitrate solution.

Stainless Steel passes acid test

at Anaconda's uranium acid leaching plant in Bluewater, N. M.

You've probably read about Anaconda's Bluewater plant. It processes all the ore from the famed Jackpile Mine about 60 miles away. 700 men work here.

The plant uses a lot of Stainless Steel—but none of it is *replacement* Stainless. Using pilot plant data, and a solid background of chemical ore processing knowledge, Anaconda engineers designed with Stainless Steel right from the drawing board on. Stainless was selected wherever acid and abrasion resistance was needed and, in the words of Anaconda engineers, "Nothing else could do the job so inexpensively."

The process starts by treating the ground ore slurry with sulfuric acid, so naturally Stainless Steel is used for the acid piping and valves. But one of the most interesting applications is further down the process line, where ion exchange RIP banks are used to remove the uranyl sulfate radicals from the muddy solution. Big four-foot-square Stainless Steel screen baskets containing strong base resins are agitated up and down to do the job. The Stainless screening, impervious to the acid, will not corrode or "blind," and a full flow of solution can penetrate to the resin.

Like other users, you will probably find that the most economical way to use Stainless Steel is *right from the beginning.* You'll also find that it pays to specify USS Stainless Steel to be sure of service-tested quality.

Watch the **United States Steel Hour** on TV every other Wednesday (10 p.m. Eastern time).

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
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USS STAINLESS STEEL

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SHEETS • STRIP • PLATES • BARS • BILLETS • PIPE • TUBES • WIRE • SPECIAL SECTIONS

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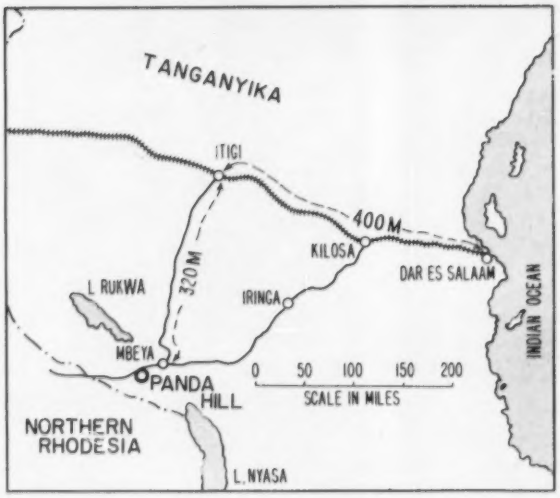
UNITED STATES STEEL

Mbeya Exploration Opens Tanganyika Columbium



OUTPUT OF PANDA HILL when the production facilities are constructed, will be shipped by truck to Itigi and then by rail to the port of Dar es Salaam. About 10 tons per month will be forthcoming in 1958, with a 2,000 tons-per-year output scheduled for 1962. Mbeya Exploration, the operator, is co-owned by Billiton and Colonial Development Corp. Columbium concentrates will be shipped.

MBEYA EXPLORATION CO.'S columbium pilot plant and milling operations at Panda Hill, Tanganyika, are in last stages of construction. Acting as the forerunner for permanent production plant, present facilities are expected to turn out 10 tpm during 1958. Scheduled to be ready for operation in 1962, production plant should have a capacity of 2,000-2,500 tons per year.

Eventual production plant power will come from one of two sources; hydropower development on the Kiwira river (40 miles south of Panda Hill) or from steam produced between the Kiwira and Songwe rivers.

Panda Hill, flanking the rift valley between Tanganyikan Lakes Rukwa and Nyasa, is 24 miles south of Mbeya and near Northern Rhodesia's border. Hill's columbium deposit was originally found by Tanganyika Geological Survey fieldmen, and, in 1954, exploration rights were granted to Mbeya Exploration Co. (N. V. Billiton Maatschappij, The Hague, and London's Colonial Development Corp.).

Entire area at Panda Hill consists of carbonatite which, as a result of diamond drilling to depths of 150 ft combined with channel and bulk samplings of adits, indicates an ore reserve of 50-million tons. This reserve covers only a fraction of the whole carbonatite body. Deepest vertical borehole found no appreciable change in values over 750 ft in solid carbonatite, while adits in Hill's eastern slope showed continuation of ore to a depth of 600 ft below carbonatite's top level.

Greater part of Panda Hill consists of erosion-exposed pyrochlore ore which makes possible large-scale open pit operations. Extensive testwork both in Billiton's ore dressing laboratories at Arnhem and in a small test plant at Panda Hill have shown that recovery of fairly high grade concentrates by conventional methods is possible with a fair recovery of colombium values. The ore can be compared to a medium-hard limestone for grinding and crushing purposes. After grinding through 30-65 mesh, large percentage of gangue can be discarded by gravity concentration methods. Further upgrading of the preconcentrates prepared in this manner can be done by a combination of flotation and magnetic separation.

By these methods, concentrates containing 40-50% Cb_2O_5 can be prepared while acid leaching may raise Cb_2O_5 content to 50-70%.

Alaska *(Continued)*

mortgage on the property—$2,894,575. The only other bid, by International Industries of Tacoma, Wash., was in a lesser amount.

United States Tin closed the mine in November 1955, as a losing project.

Kendrick Bay Mining Co., Climax Molybdenum Co. subsidiary, has shut down its uranium mine on Bokan Mountain for the winter. By the end of October, four barge loads of ore were scheduled to be shipped from Kendrick Bay, and the fifth (and last) barge load was to go in early November. Shipment is through Seattle to the new Ford mill near Spokane.

ARIZONA

A single Arizona department of mines and minerals, consolidating all the various existing agencies, has been proposed by Harvey W. Smith, Phoenix engineer, and is under legislative consideration.

Present agencies include the department of mineral resources, bureau of mines, Arizona Development Board, copper tariff board, state mine inspector, and state mine dust department.

Smith stresses all the agencies presently are doing a good job—but there is duplication of effort; there is no coordinating body or director to keep various activities in the same plane, and there is no overall plan to maintain Arizona as the dominant nonferrous mineral producer.

His proposal calls for:

1. Reorganization of the various agencies into one unit under a single board;
2. Organization of a state mining association supported by all elements of mining;
3. Establishment of a clear-cut mine taxation procedure to replace the present negotiated methods.

CALIFORNIA

Kerr-McGee Oil Industries, Inc., recently prepared to launch a search for saline deposits on 14,885.75 acres leased from the Southern Pacific Land Co. Site of the search is in the Boron area near the U. S. Borax open-pit mine.

Kerr-McGee has rights to salines and other evaporites including compounds of sodium, potassium and boron, according to terms of the 25-year lease. Test holes are to go to saline ore or to basement, about 2,000 ft. Terms provide for payment of 10% royalty on sales value of crude saline ores or 5% of sales value of saline products and 10% of the value of by-products.

The company paid a cash rental of $14,885.75 for the first year, and will pay $1 per year per acre rental in succeeding years. Contract stipulates that the company will drill the first test hole on or before June 1, 1960, and then continue drilling until one hole has been drilled on each of 26 parcels. Kerr-McGee will be allowed 90 days between holes.

Mining rights were leased for land in Kern and San Bernardino Counties.

Macco Corp.'s drilling-mud operations near Rosamond are being slowed down from a 24-hour-7-day basis to an 8-hour-5-day basis, company spokesmen say.

Meanwhile the warehouse center at the Rosamond mill is being scattered to warehouse points at Rio Vista, Bakersfield, Ventura and Paramount.

General slowdown is occasioned by

B.F.Goodrich

Three retreads . . . still going strong

20 hours a day, 6 days a week, this truck hauls giant loads of coal over West Virginia and Pennsylvania roads covered with slag and stony shale. It's tire-killing work, yet these B.F.Goodrich Universals have been retreaded *three times* and are still going strong.

Full traction up steep grades

Trucks like this one carry anthracite—coal loads as heavy as 30 tons, up steep roads strewn with razor-sharp rock. But B.F.Goodrich Universal tires give positive traction, and more than 3,500 hours of service before retreading!

Miners get more retreads, better traction, bigger savings with B.F.Goodrich tires!

50% saving The wheels of this truck roll over some of the roughest terrain in the Pennsylvania anthracite region. But their B.F.Goodrich Universal tires stand up so well, they can be retreaded to give an additional 75% of new tire performance. No wonder the operator saves as much as 50% with B.F.Goodrich tires.

REPEATED experiences of miners—like the three shown here—prove that B.F.Goodrich FLEX-RITE NYLON Universal tires give more retreads, superior traction and bigger savings. Reason: the combination of the Universal tread design and the B.F.Goodrich FLEX-RITE NYLON cord body.

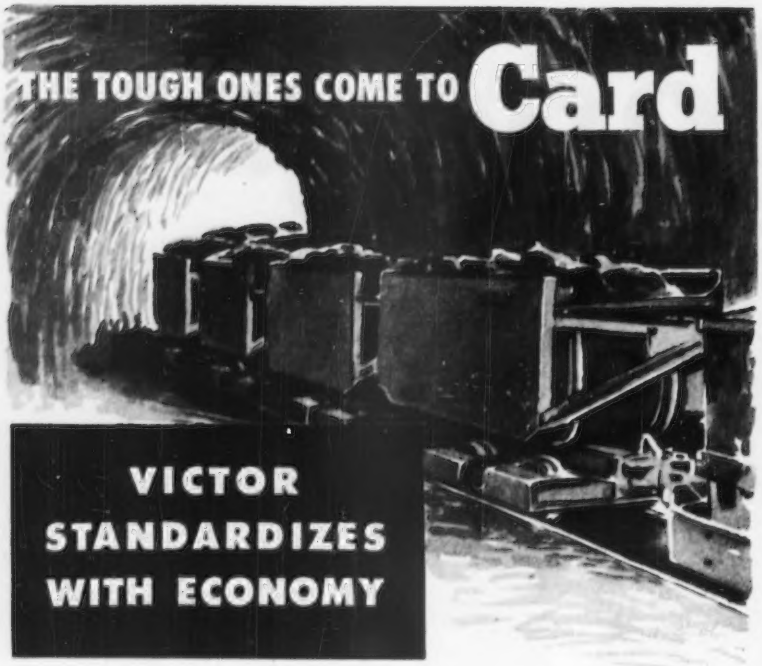
Husky, wedge-shaped cleats grip the ground for positive traction. The B.F.Goodrich FLEX-RITE NYLON cord body is stronger than ordinary cord materials, withstands double the impact and resists heat blowouts and flex breaks. Result: the B.F.Goodrich cord body outwears even the extra-thick tread, can be retreaded over and over.

Your B.F.Goodrich dealer has a tire for every kind of mining work. See him today or write: *B.F.Goodrich Tire Company, A Division of The B.F.Goodrich Company, Akron 18, O.*

Specify **B.F.Goodrich tires when ordering new equipment**

B.F.Goodrich
FIRST IN RUBBER

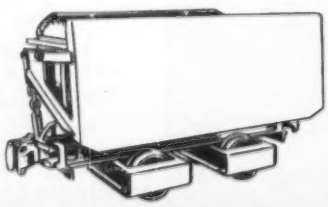
Your B.F.Goodrich dealer is listed under Tires in the Yellow Pages of your phone book



The Maiden Rock Mine of Victor Chemical Works first started using Card cars in 1950. Chosen design was a Granby type car of 57 cu. ft. capacity built on 24" gauge and featuring coil spring suspension. The phosphate rock being handled is relatively clean to handle, and the car design is unusually well suited. As a result, not a single Card car has ever had any significant repairs although some wheels have been replaced. Fifty-two of these cars are now in service, representing several re-orders over a four-year period.

Much of the haulage at Maiden Rock is underground, and many of these Card cars seldom see the light of day. The steady day in, day out service record of the cars has meant high production with remarkable economy for Victor—one of the three largest producers of elemental phosphorus.

Standardize your haulage with an economical Card design. Our engineers can furnish an efficient car to meet your most difficult specifications.



C.S. Card Iron Works Co.
2501 WEST 16TH AVE.
DENVER, COLORADO

California *(Continued)*

decreased activity in the oil industry, while the warehouse shift is an economy effort to cut down on "double trucking" by having thinners and other chemicals delivered directly to Rio Vista, Bakersfield, Ventura and Paramount for mixing prior to shipment to users.

Still being maintained is Macco's Nine-Mile Canyon barium mine. Material stockpiled now will last through the winter, but mining operations will start up again in the spring.

National Tungsten Co., which recently closed down its mine near Deer Creek in Tulare County, is going into oil and uranium operations, according to reports. The company is drilling a shallow well in the Round Mountain district of Kern County and it reportedly leased the Sierra Mining Co. property in the Jackass Mining District of Madera County.

COLORADO

Beaver Mesa Uranium Co., Grand Junction, is speeding mine output in order to strip its reserves before end of uranium purchase program on March 31, 1962.

Alan M. Simpson, Grand Junction, says in annual report to shareholders that the firm will double present production rate of 6,000 tons of ore monthly as a result of acquisition of $80,000 in machinery.

He gives Beaver Mesa 345,000 of proved reserves "on conservative estimate" and inferred reserves at various properties of 690,000 tons.

Miracle Mines, Ltd., of Denver said it is starting a large-scale operation to produce platinum from ores discovered 22 miles southeast of Walden in northwestern Colorado.

Miracle Mines is a partnership. The general partners are Thomas A. Roller of Evergreen, Myron Riebold of Durango, and Gould Beech, Houston, Tex., real estate man. Roller said there is no stock for sale.

The firm holds mining claims on 1,500 acres of public land in the Routt National Forest.

Roller said the operation would represent the first production of platinum in the continental U. S. in the last 39 years. He said the claims are 70 airline miles from the Rambler Mine which produced platinum from 1900 to 1918. The Rambler Mine is near Encampment, Wyo.

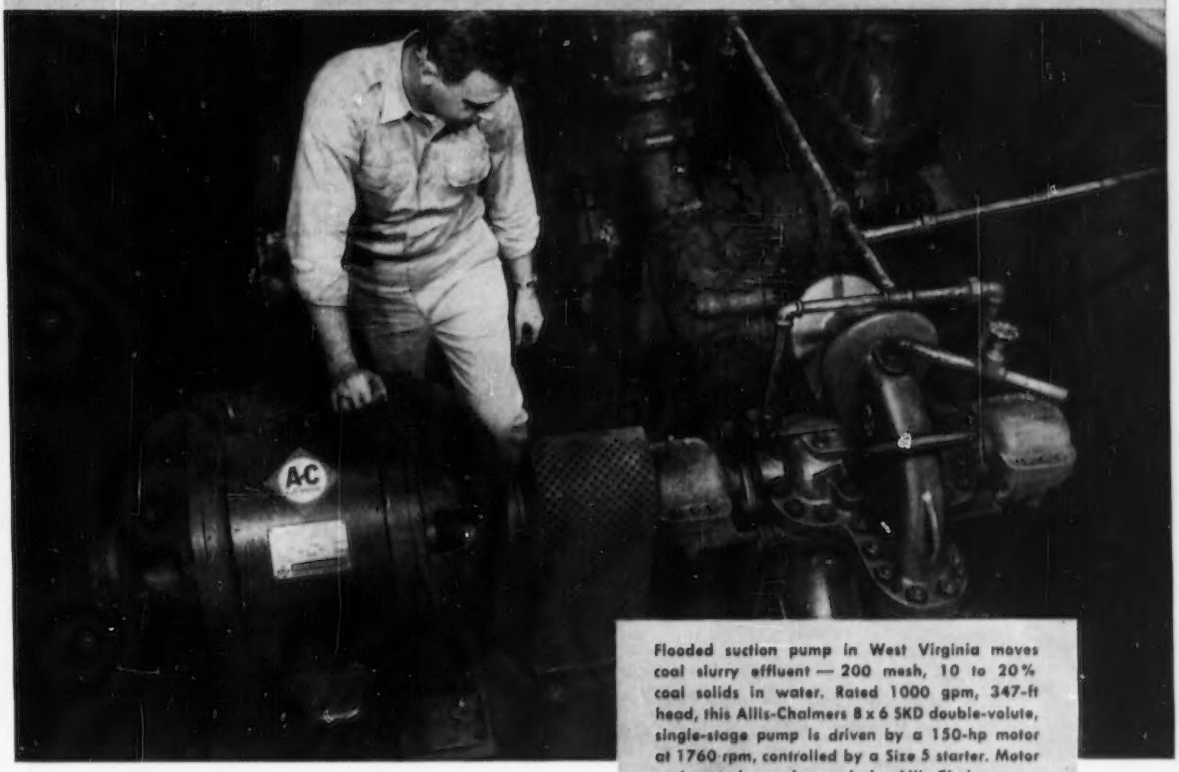
Roller said the platinum lands were discovered eight years ago by two weekend prospectors, Oscar Weiss and Albert Latham Jr., both of Denver.

The firm is conducting laboratory studies to determine the best means of extracting platinum from the ore at the site.

Roller said assays conducted by a Denver firm indicated the ore would bring from $9 to $50 a ton. Platinum now brings $85 an oz.

Metals shown in the assays include platinum, osmium, ruthenium, rhodium,

Coal-Washing Savings with Allis-Chalmers Pumps



Flooded suction pump in West Virginia moves coal slurry effluent — 200 mesh, 10 to 20% coal solids in water. Rated 1000 gpm, 347-ft head, this Allis-Chalmers 8 x 6 SKD double-volute, single-stage pump is driven by a 150-hp motor at 1760 rpm, controlled by a Size 5 starter. Motor and control are also made by Allis-Chalmers.

Custom-Assembled Pump Costs Less than a Standard Pump

Nodular iron, developed by Allis-Chalmers, cuts the cost of this pump. The ribbed casing was cast in *nodular* iron — it has the tensile strength of the standard pump made of steel but costs considerably less. Adjustable wearing rings are made of stainless steel. This application typifies Allis-Chalmers ability to custom-assemble liquid and solids handling pumps from standard components made of a wide variety of metals and alloys — to meet any conditions of temperature, corrosion and abrasion.

You Get MORE Pump Value... When You Specify Allis-Chalmers

... because Allis-Chalmers pump development is based on extensive experience gained in supplying standard and special pumps to all industries for many years.

... because you specify from the world's widest pump range (1½ to 72 inches).

... because you get pump application and engineering advice from experts anxious to help you.

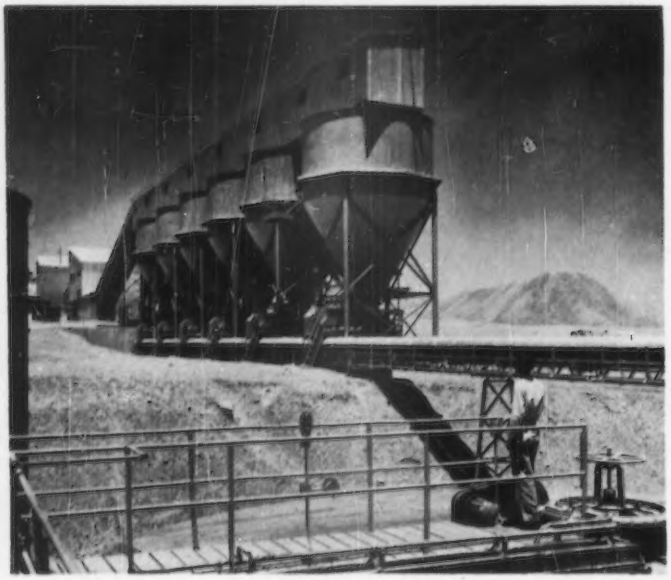
and MORE

... because Allis-Chalmers is the only company that offers pump, motor, drive and control as a unit, designed to work together — all built by one source, for "one source" responsibility.

For detailed pump information contact your local A-C office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5305



Blending . . .

Ore blending is particularly important in some uranium concentration. Multiple storage and conveying designed and built by Stearns-Roger has met the requirements of this southwestern producer. For materials handling, as for other important operations in the processing of metallic or non-metallic ores, rely on the complete services of Stearns-Roger for design, engineering, fabrication or field erection.

Stearns-Roger

THE STEARNS-ROGER MFG. CO. • DENVER, COLORADO

DENVER • HOUSTON • EL PASO • SALT LAKE CITY

Stearns-Roger Engineering Company, Ltd., Calgary, Alberta

There is no substitute for experience . . .

Colorado *(Continued)*

iridium, palladium, germanium and gallium.

A large sluicing operation has been started at the site to produce 8 to 10 tons of concentrate weekly. Research is being conducted on other methods of recovery, Roller said.

Frank Pettit, consulting metallurgist of Arvada, Colo., said he believes a method can be developed to recover columbium, tantalum, indium and thalium as well as the other metals.

Roller said as soon as Pettit has determined the most satisfactory recovery method Miracle Mines will build a mill.

Ohio Oil Co. and Arthur E. Pew have notified the AEC at Grand Junction that they have decided to defer building a mill to extract uranium concentrate from lignite occurring in the western parts of North and South Dakota, "pending development of improved ore processing or a greatly increased demand for uranium oxide." They indicated that, as a result of their process studies, their proposed operation was not economically feasible at the ceiling price of $10.50 per lb U_3O_8 contained in acceptable concentrates derived from lignite.

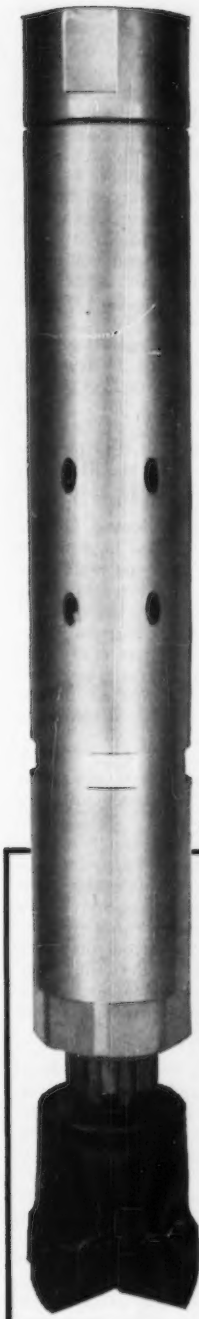
Core drilling is in progress in Picayune Basin near Silverton to estimate the extent of the manganese-bearing rhodonite ore in that section of San Juan county. The property being drilled is part of the U. S. Manganese Co., a company formed by the Great Divide Mining & Milling Co. and Vitro Corp. Two core drills are being used and holes are drilled at about 400-ft intervals to a depth of 250 ft. The first phase of the operation calls for six holes.

For many years, mining men have known that extensive deposits of rhodonite exist in the Silverton area. It is a rather massive, very hard rock, ranging in color from rose-red to pink, where freshly broken, to brown or blackish where weathering has covered surface with manganese oxide.

Golden Cycle Corp. directors meeting at Colorado Springs decided to defer consideration of a third-quarter dividend to their December meeting. President Merrill E. Shoup said that payment of a dividend for the last half of 1957 would be considered in December. Shoup said Golden Cycle's net interest in uranium production soon will amount to 9,500 tons of ore a month, including 2,000 a month from its own Atkinson Mesa property at Uravan. Golden Cycle is now considering a long term financing program for development of its uranium properties, Shoup said.

Gold receipts at the Denver mint slipped to 55,102 oz worth $1,928,571 in September from 57,328 oz worth $2,006,512 in September 1956. The drop in gold output from curtailed operations at lead and copper mines means that they are not getting as much by-product gold as they were under normal operations.

Silver receipts were down to 14,789 oz worth $13,360 from 583,474 oz val-



NEW GARDNER-DENVER "MOLE-DRIL"

(Trade-Mark)

hits the bit where it bites

This drill follows the bit right down through the rock. It cuts deep, big-bore holes . . . reduces drilling time and costs. The Gardner-Denver "Mole-Dril" adds more versatility to any rotary drilling rig.

DELIVERS MORE FOOT-POUNDS OF ENERGY . . .

to the bit than any other drill of its size. No power is lost regardless of drilling depth with this in-the-hole "Mole-Dril". There are no drill rods between drill and bit absorbing hammer shock.

DELIVERS AIR AT FULL PRESSURE FOR CLEANING

Hole cleaning ability is not completely dependent on exhaust air from drill. A separate air stream flows directly through bit at full line pressure to keep cutting face clean. The drill has up-cast exhaust air ports to give cuttings an added boost.

ONLY 3 MOVING PARTS

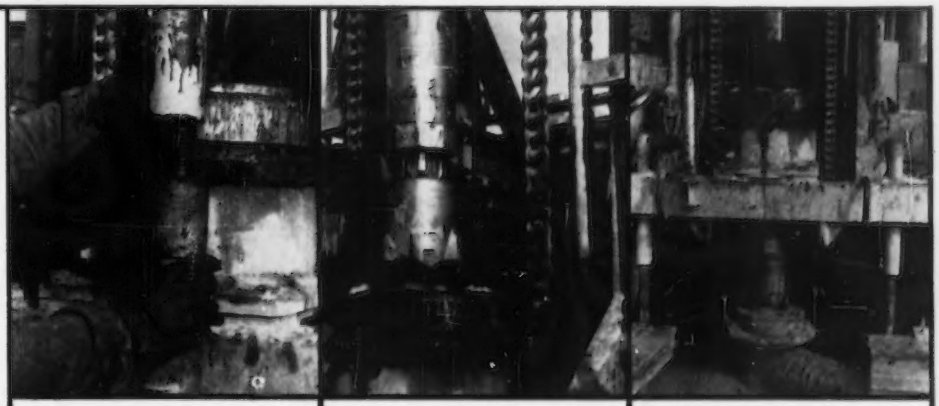
Rugged, simple construction delivers more work and less trouble. There are only nine major parts in the entire drill.

Two sizes available—here are the condensed specifications

	diameter	length	weight	recommended bit size
Model AM6	5¾"	38.6	200 lb.	6½"
Model AM4	4"	35.6	98 lb.	4¾"

Get the most out of your rotary drilling rig . . . save money . . . drill faster . . . get the new Gardner-Denver "Mole-Dril"

Patent Pending



Drill screws directly to standard drill pipe . . .

Bit screws directly on to drill tappet . . .

and down they go

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IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

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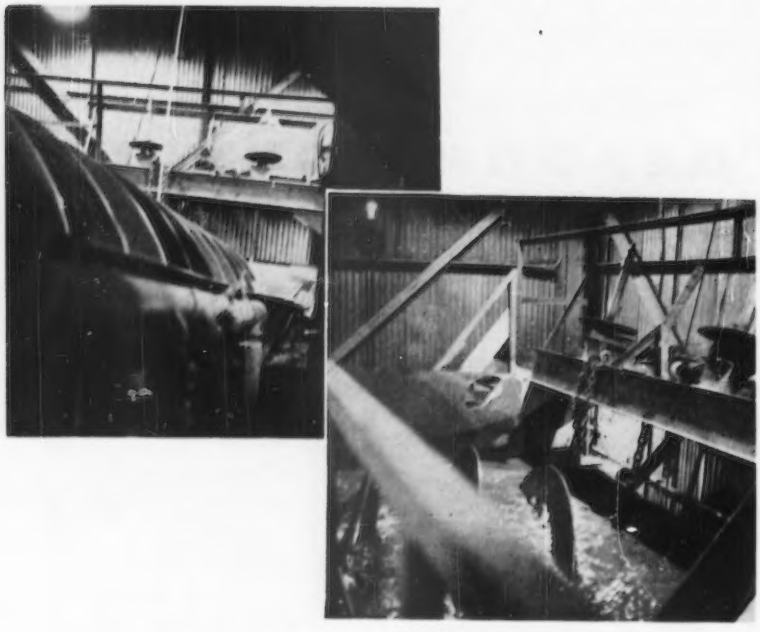

TWO 78" AKINS CLASSIFIERS

17 years continuous operation on the Iron Range

. . . many years of service left

- Service like this is just one of the many reasons why Akins are preferred
- This company, on the Iron Range, has approximately 50 Akins

SPECIFY AKINS

The Original Spiral Classifier, and the Only Spiral Heavy-Media Separator

COLORADO IRON WORKS CO.

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AKINS CLASSIFIERS • SKINNER ROASTERS • LOWDEN DRYERS

Sales Agents and Licensed Manufacturers in Foreign Countries

A SUBSIDIARY OF THE MINE & SMELTER SUPPLY CO

Colorado *(Continued)*

ued at $528,060. The world price of silver continues above the fixed U. S. government price.

Little Dora mine, on Sultan Mountain at Silverton, now has 18 men at work and is sending 50 tpd ore to the Pride of the West mill at Silverton, reports Giant Resources, Inc., which is operating the Little Dora. Settlement sheets for the five recent weeks indicate that something over 1,500 tons of ore were mined and milled, resulting in some 87 tons of concentrates which gave gross smelter returns of $30,731.93. The concentrates showed metal values of 3.46 oz gold, 138.6 oz silver per ton and additional content of 13% copper and 42% lead, giving a concentrate value of $355 per ton.

George Hazen, mine superintendent, says the Little Dora vein is averaging between three and five feet in width. Proven reserves on the A level of the Little Dora are estimated at $800,000 say company officials, and they plan an exploration program on the 30 claims held by the company in that area.

Trail Mines, Inc. of Colorado Springs is reported to have shipped its first 100 tons of thorium ore from its mine near Cripple Creek to a mill for up-grading and that after processing the product will be sent to an eastern chemical company for final treatment and conversion into product for military and commercial use, according to Wm. Ewing, general manager and R. G. Silvola, vice president.

Ore was taken from a mine on the Old Gold Camp road on land leased from Ralph Otto and Associates, according to Ewing.

"The average mill sample ran a minimum of 10.5%. Trail Mines also has mining claims in the Hardscrabble mining district between Wetmore and Rosita in Custer and Fremont counties," according to officials. "Ore from that area has also been shipped to the mill," they said. "We plan to produce about 500 tons a month of thorium ore in the near future."

W. M. Dickerson, S. S. Irving and R. I. Coombs made a business trip to Denver recently at which time they completed negotiations with the Mace Co. there and contracted for the construction of a sintering hearth and related equipment for the Saguache smelter. This completes a major step in the process of the plant to the producing stage. John R. DuVall, who is metallurgist and chemist for the Smelting Company, says there is ample ore and concentrates being produced to supply the plant.

Union Oil Co. of California technicians say they have succeeded in simplification of the retorts used in extracting oil from oil shale at its Grand Valley plant, and they say this brings nearer the time when it will be commercially feasible to begin using the tremendous reserves of oil and gasoline which are now locked within the huge oil-shale deposits

Here's what makes Walworth Bronze Valves *the* real bargain!

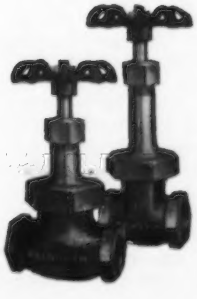
TYPICAL OF WALWORTH QUALITY is the union body-to-bonnet connection which stiffens the body against internal pressure; makes taking the valve apart a simple operation and reduces the chances of distortion or leakage even though the valve is repeatedly taken apart and reassembled. With this type of construction there is no possibility of the bonnet coming off the valve while the handwheel is being turned.

HEAVY BODY CONSTRUCTION is typical of *all* Walworth Bronze Valves. Extra-thick walls and rugged wrench hexes constitute a high safety factor and prevent distortion while the valve is being installed in the pipeline. Extra-deep pipe threads are accurately machined to eliminate leakage. Walworth Bronze Valves are also available with flanged, silver-brazed or soldered ends in certain sizes and types.

EXTRA-LARGE STEMS with extra-long, extra-deep threads prolong valve life, protect against wear and distortion and provide tight positive shutoff. The surface of the stem is machined to a glass-like finish for minimum handwheel effort and to preserve the packing which results in fewer inspections and less maintenance. The top of the stem is tapered and squared to hold the handwheel securely.

TO REDUCE WIRE DRAWING to a minimum, certain types of bronze globe valves have stainless-steel plug-type seats and discs heat-treated to a nominal hardness of 500 Brinell, adding years to valve life even in severe services. These valves can be tightly closed on sand, grit or pipe scale without damage. Seats and discs are machined simultaneously, assuring perfect mating.

There is a Walworth Bronze Gate, Globe, Angle or Check Valve for every service. Walworth is continually developing new valve types and materials, including plastics, to keep pace with the growing variety and severity of services in modern industry. For full information, see your Walworth Distributor or write: *Walworth, 60 East 42nd Street, New York 17, N.Y.*



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Tomorrow's
MODERN DESIGN
for
Today's Demands!

MORRIS PUMPS
keep the aluminum industry rolling toward
GREATER CAPACITY

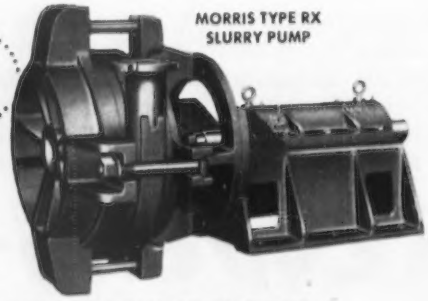
In pace with the far-sighted aluminum industry, other leading manufacturers the country over shrewdly specify Morris for heavy duty pumping.

The Morris Type RX Slurry Pump is rugged, dependable, and trouble free. It's specifically designed for heavy pumping; gives peak performance under all conditions, including heavy, coarse or fine slurries, dispersions and sludges.

The Morris pump operates with minimum attention . . . lowers maintenance costs . . . can be quickly dismantled for inspection . . . avoids lengthy lay-up time. For heavy duty pumping specify Morris.

WRITE TO MORRIS TODAY for recommendations of the pump best suited to your size, capacity, specifications. Ask for Bulletin 185.

MORRIS
CENTRIFUGAL
PUMPS



MORRIS TYPE RX
SLURRY PUMP

MORRIS MACHINE WORKS
Baldwinsville, N. Y.
Sales Offices in Principal Cities

Colorado *(Continued)*

of Colorado and Utah.

Through John R. Pownall, superintendent of the Grand Valley plant of Union Oil Co. comes word that this simplification of process may cut about $250,000 from the construction cost of each retort. Prior to this development it had been estimated that the retorts, when built in series, would cost about $2-million each, and that when operation on a commercial scale should start, the first plant should consist of at least 10 retorts, or $20-million. It seems that the simplification which has been worked out in the present test-plant not only lessens original construction cost, but lessens operative expense.

U. S. shale oil reserves are bigger than previously estimated, according to the Bureau of Mines. New analyses of cores of oil shale beds show them to be thicker than reported earlier. As a result, estimated reserves of oil in Colorado shale have been boosted from 1-trillion bbl to 1.5-trillion bbl. Estimates for Utah and Wyoming have been raised another 35.6-billion bbl.

A large mine development enterprise in the Idaho Springs area financed principally by Ventures, Ltd. of Toronto, Canada is under way. The old Big Five or Central tunnel, heading under Bellevue Mountain at the west side of Idaho Springs has been rehabilitated for something over 8500 ft of its more than 9,000-ft total length. The clean-up progress is now at a point directly under where it will be tapped by an air-shaft being drilled from the surface, 1700 ft above. Beaver Lodge Uranium Co. is also associated with Ventures, Ltd. in the project.

The work is being carried on by the Contract Engineering Co. of Denver of which Albert W. Hoyle is the active head. Engineer Hoyle reports that the 16-in. air shaft has now reached a depth of 350 ft and is being carried along steadily and that a second 5-in. hole has been started nearby with a rotary rig, this latter hole to be used for electric transmission cable, etc. and now is down 150 ft.

Golden Cycle Corp. of Colorado Springs in a special report on current uranium activities says that in addition to the Atkinson-Mesa uranium property owned and operated by Golden Cycle the corporation has now consummated two additional uranium transactions of magnitude. At the Atkinson-Mesa near Uravan, Montrose county, production of uranium ore shows a substantial gain for the first half of 1957 compared to the same period in 1956 and it has been the best six months' operation in its history.

IDAHO

J. R. Simplot Co., Boise, plans to construct a $1-million clay processing test plant near Bovill in north central Idaho.

Large mill hammers taken from the scrap pile needed a 2" to 2¼" build-up on length . . . required approximately 5 lbs. of Manganese and Stoody 100, combined. Smaller amounts of build-up and hard metal are required for subsequent maintenance.

DON'T THROW AWAY 9/10 OF EVERY MILL HAMMER

The Victorville Lime Rock Company on the Mojave Desert some 75 miles from Los Angeles operates a plant for the reduction of high grade limestone that is processed for a great many uses, from face powder base to roofing materials. For intermediate crushing the company uses a hammer mill and maintenance is, of course, the usual problem.

When a Stoody representative first called at this plant he found a scrap pile of worn hammers that had been discarded in favor of standard replacements. 9/10 of the hammer was still there but so severely worn as to have lost its efficiency. A set of nine new hammers represents an investment of approximately $200.00, so the huge scrap pile, to the hard-facing specialist, had all the appearance of a gold mine.

Tests were undertaken to determine the cost of rebuilding such hammers; a copper form was clamped around the worn end to fix the shape and the finish length. Using the semi-automatic welder running Stoody Nickel Manganese, the hammer was brought back to just under finish size, then peened and hard-faced on the end and corners with Stoody 100.

The original experimental rebuilding job proved successful and the procedure outlined has now been established as routine. New hammers measuring 4"x5"x10½" weigh 45 pounds. Between four and five pounds of Manganese and Stoody 100, a high-alloy, wear-resistant material, are required to bring a worn hammer back to size. The semi-automatic welding procedure is extremely fast, depositing three to six times as much weld metal as is possible by the manual method. After rebuilding, each hammer is carefully weighed and balanced for proper operation of the mill. As wear occurs in service, the semi-automatic welder is used to apply additional Stoody 100 free hand to maintain hammer size and shape.

By the method described hammer costs are enormously reduced and the mill's performance is considerably improved.

Further information on the hard-facing of all types of crushing equipment is provided by various pieces of Stoody literature. See your Stoody dealer (you will find him in the "Yellow Pages" of your phone book) or write direct.

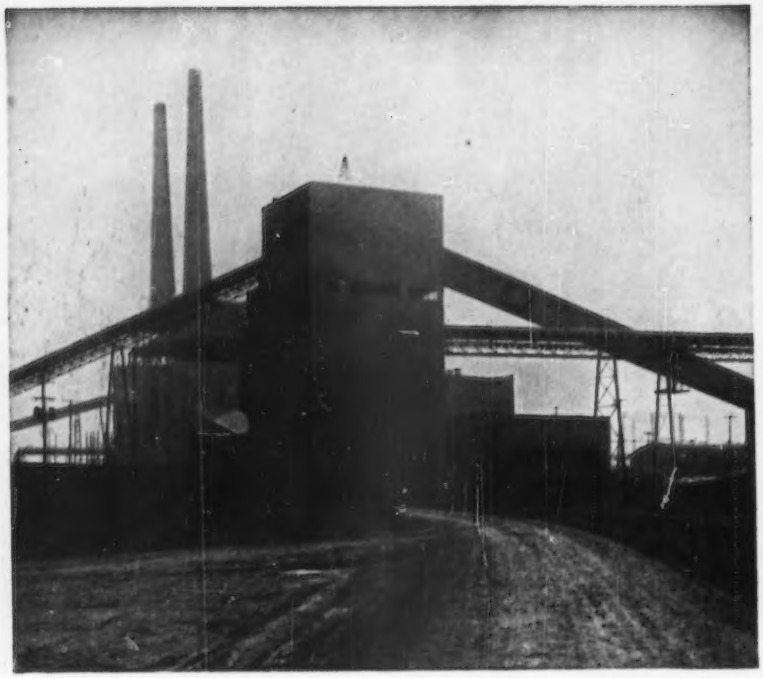
George Stone, Maintenance Superintendent, shows turn-table fixture which speeds welding. Forms surrounding hammers are copper, establish hammer size and height of build-up.

Other hard-facing includes these quarry shovel teeth. Points are rebuilt with Stoody Manganese and hard-faced with Stoody 100. Note the copper mold which shapes the point.

STOODY COMPANY

11930 E. Slauson Avenue

Whittier, California



Moves a million-ton mountain of coal a year!

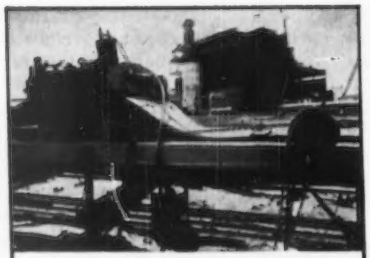
One of the largest in the U. S., this system depends on over 7,000 feet of Quaker Rubber belting to keep the coal moving.

PROBLEM: The Detroit Edison Company needed three separate conveyor systems to carry coal into their River Rouge power plant: (1) dock to storage, (2) dock to breakers to plant, (3) storage to breakers to plant.

SOLUTION: Quaker engineers and the Quaker distributor's men, working with engineers of the power plant, suggested the use of a belting designed for high lifts and long center distances. Over 7,000 feet was installed.

RESULT: The three conveyor systems work smoothly and efficiently, carrying coal into the plant at the rate of one million tons a year.

YOUR PROBLEM: Whatever your conveyor needs, whatever your industry—there's a Quaker Rubber Belt (or Hose) of the *right* construction to handle the job safely and economically. Quaker engineering service is available for the asking.



To make sure 7,000 feet of Quaker Rubber conveyor belting (available in 48", 60" and 72" widths) was properly installed, splicing and vulcanizing of the belting was supervised by a Quaker Rubber specialist.

For your free brochure on conveyor belting, write your nearby Quaker Rubber distributor, or:

H. K. Porter Company, Inc.,
Quaker Rubber Works,
Philadelphia 24, Pa., or
Pioneer Works, Pittsburg, Calif.

H. K. PORTER COMPANY, INC.
QUAKER RUBBER DIVISION

Idaho *(Continued)*

Firm expects design work on the plant to be completed within the next six months. The company currently has mining leases on 2,000 acres of state land near Bovill.

Charles W. Sweetwood, assistant manager of the exploration division of the company, said the target date for starting the plant is June 1. The company is interested in the clays of Latah county for upgrading to provide raw material for manufacture of ceramic, insulator and paper products.

Silica from the processing would be sold to glass and enamel manufacturers. Other uses for the clays and silica will be tested.

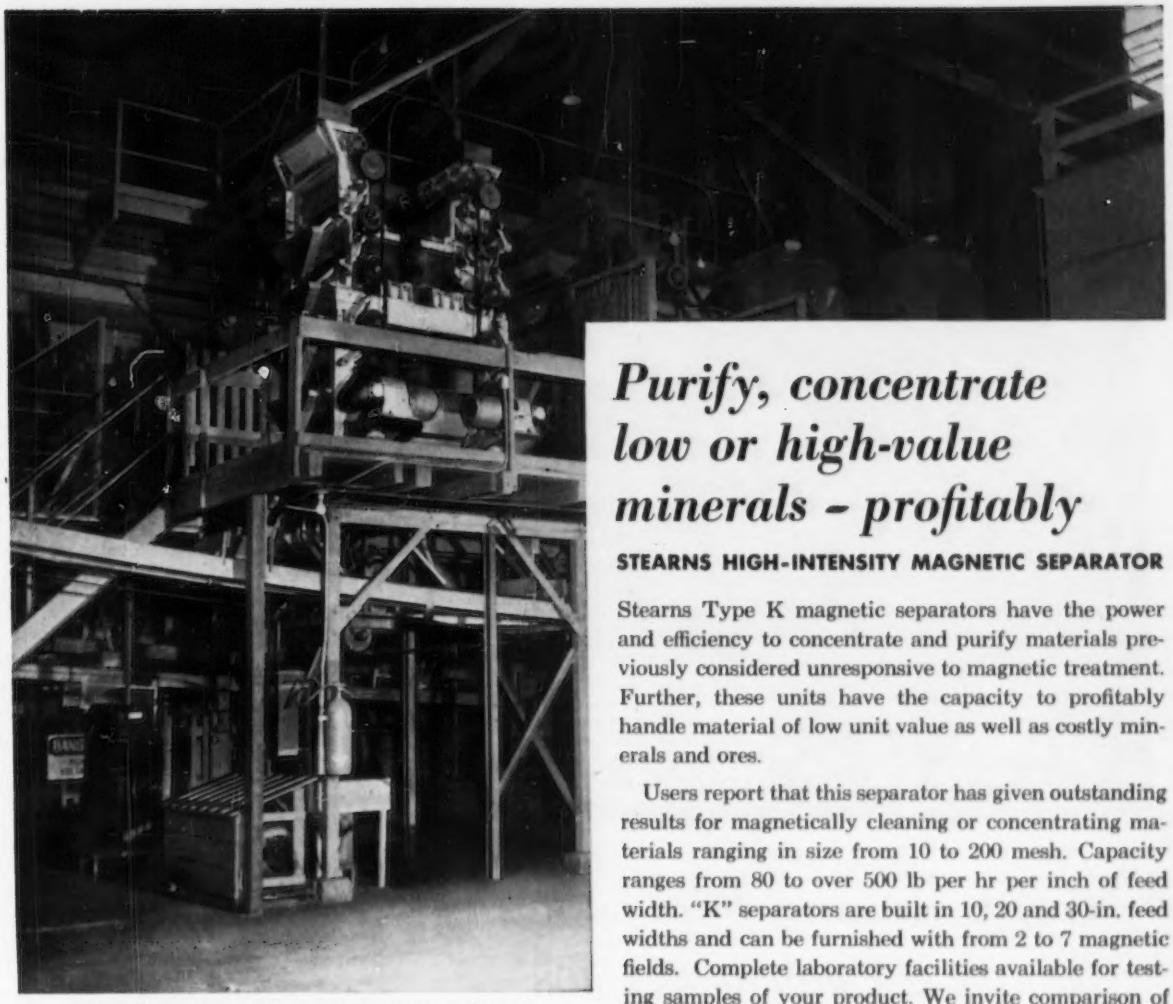
Porter Brothers Corp., a construction company which turned to mining shortly before World War II, is currently producing practically all the domestic supply of the strategic minerals, columbium and tantalum from its dredging operations along Bear Valley creek in Valley County, about 70 miles northeast of Boise. Company works two dredges around the clock seven days a week for about nine months of the year with a crew of about 50 men. Another 50 men are employed on a year-around basis at the firm's concentrating plant at Lowman. Recoveries from the heavy black sands include columbium, tantalum, monazite, uranium and rare earth minerals.

Federal Uranium Corp. of Salt Lake City has considerably expanded its holdings in the Lakeview area of Bonner County through acquisition of operating control of Idaho Lakeview Mining Co.'s Keep Cool and Hewer properties adjoining Federal's Conjecture mine operation. The additional claim groups, both of which yielded some early-day production and have been mined intermittently in recent years by Idaho Lakeview, were acquired, R. W. Neyman, Federal president, said, because of the encouraging results which have been obtained in recent development work at the Conjecture.

Since taking over operation of the Conjecture about a year ago, Federal has deepened the 1½-compartment, inclined shaft from the 500 to the 700 level and has completed some 650 ft of drifting on the new lower horizon. The drift has already exposed the downward projection of one ore shoot, disclosing more ore of better grade than on the 500 level, and is now being advanced toward another orebody.

Federal's plans are to drift out the two ore zones and then diamond drill downward to check the structures at greater depth. If results warrant, a vertical 3-compartment shaft will be put down to the Conjecture 1,000 level to serve as deep-level access for all three properties. Principal ore values are silver, with some lead and zinc.

The new agreement entitles Federal to recover its exploration and development costs out of first profits from the Idaho Lakeview groups. Subsequent



Here a Stearns Type "K" separator is processing ilmenite in a southeastern plant.

Purify, concentrate low or high-value minerals - profitably

STEARNS HIGH-INTENSITY MAGNETIC SEPARATOR

Stearns Type K magnetic separators have the power and efficiency to concentrate and purify materials previously considered unresponsive to magnetic treatment. Further, these units have the capacity to profitably handle material of low unit value as well as costly minerals and ores.

Users report that this separator has given outstanding results for magnetically cleaning or concentrating materials ranging in size from 10 to 200 mesh. Capacity ranges from 80 to over 500 lb per hr per inch of feed width. "K" separators are built in 10, 20 and 30-in. feed widths and can be furnished with from 2 to 7 magnetic fields. Complete laboratory facilities available for testing samples of your product. We invite comparison of results. Write today for Bulletin 701-BD.

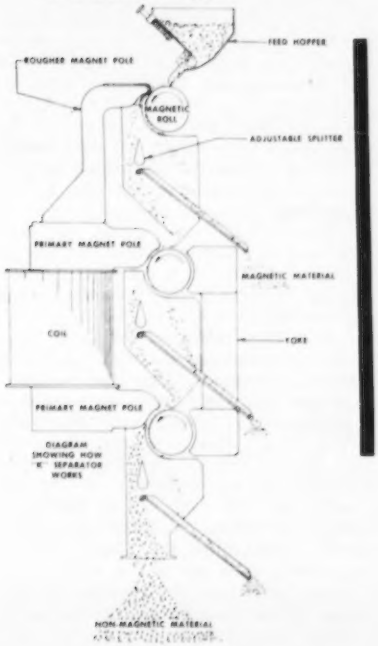


DIAGRAM SHOWING HOW "K" SEPARATOR WORKS

Here are some products the "K" handled profitably:

Product Purification

Silica Sand
Scheelite
Soda Ash
Abrasives
Silicon Carbide
Aluminum Oxide
Pottery Clay
Fire Clay
Kyanite
Nefheline Syenite
Barite

Product Concentration

Manganese Minerals
Ilmenite
Monazite
Chromite
Columbium Ores
Tantalum
Wolframite

Features that put the "K" out front:

1. Magnetic field protected against flux leakage—Magnet support frame is not part of magnetic circuit. Specially constructed steel rolls with non-magnetic stub shafts further insulate magnetic circuit.

2. Simple adjustment—Positive, easy control of feed rate, air gap width, splitter settings for extremely accurate separation. So simple, unskilled workers can operate and adjust it.

3. Uniform material distribution— Louver-type feeder provides uniform distribution across entire feeder width. Effective use is made of all available feed width.

4. Powerful magnetic force— Primary pole noses are scientifically shaped to give maximum flux density in separating zone — take full advantage of available magnetic flux.

5. Progressive inductive magnetization provides greater efficiency—Successive magnetic fields induce magnetic properties even in materials having low responsiveness to magnetic force.

31

STEARNS MAGNETIC PRODUCTS

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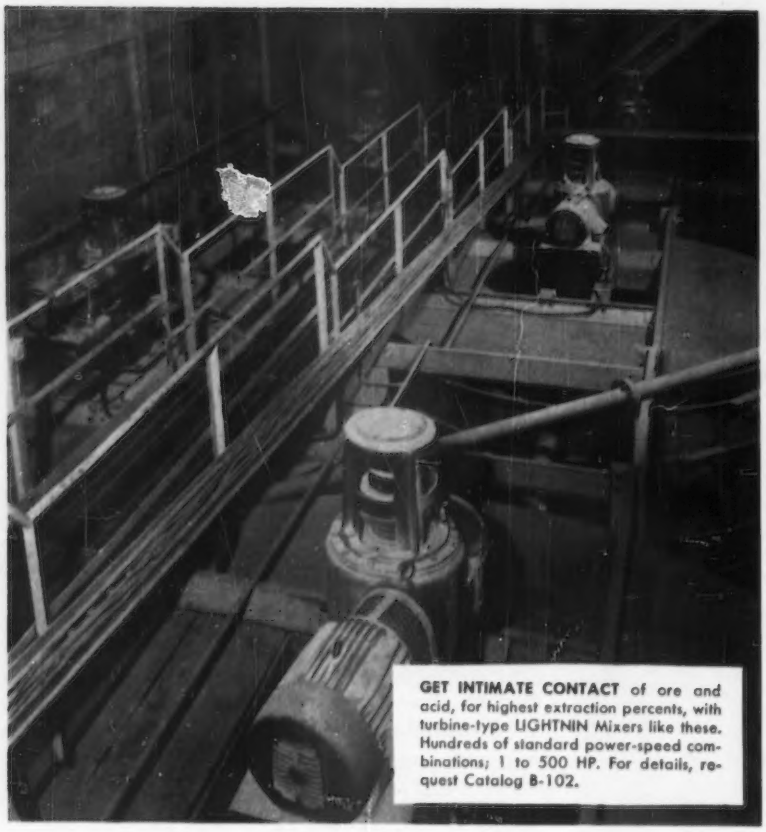


GET INTIMATE CONTACT of ore and acid, for highest extraction percents, with turbine-type LIGHTNIN Mixers like these. Hundreds of standard power-speed combinations; 1 to 500 HP. For details, request Catalog B-102.

Good mixing *helps push out half-ton per minute of U308*

More often than you might think, the payoff is in the *mixing* phase.

Good mixing of fluids helps this large Colorado plant extract uranium and vanadium with high efficiencies. The plant is designed for 30 tons/hr. of 75-80% U308 and 90% V205 concentrates, from ores averaging 0.2-0.3%.

In the dissolving tanks you see here, turbine-type LIGHTNIN Mixers put into the mix the *exact balance of fluid flow and turbulence* that will produce highest possible extraction values—by actual test.

LIGHTNINs do all these jobs

In the same plant, four LIGHTNINs mix crushed ore with leach liquor. Five others mix sand and ore slimes to prepare for releaching. Six more blend leach liquors.

Each unit is engineered specifically to do its job with maximum effectiveness.

Installation was simple, because all LIGHTNINs are shipped fully assembled, factory-aligned and ready to install. All are built of standard interchangeable components to keep maintenance and parts replacement simple. All parts are easily accessible for servicing.

Results guaranteed

Have you a tough mixing job to do? You can get a LIGHTNIN Mixer to handle it—with results *fully predictable, unconditionally guaranteed.*

For fluid mixing that helps you get more out of your ore, call your LIGHTNIN representative now. (You'll find his name in Thomas' Register.) Or write us direct.

Lightnin® Mixers

MIXCO fluid mixing specialists

MIXING EQUIPMENT Co., Inc., 234-n Mt. Read Blvd., Rochester 11, N.Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Avenue, Toronto 10, Ont.

Idaho *(Continued)*

profits will be divided 60% to Federal and 40% to Idaho Lakeview.

Metropolitan Mining Co.'s 16% interest in Sunshine Mining Co.'s production from the Yankee Girl vein within Metropolitan property netted the company nearly $5,000 during June, July and August this year. Ore output during the three-months period totaled 1235 tons averaging about 43 oz silver per ton. It was mined from the 887 stope above the 3200-ft intermediate level near the Metropolitan west boundary.

Stockholders of Sunshine Mining Co. will hold a special meeting in Yakima, Wash., Nov. 9 to consider proposals for extensive revision of the company's articles of incorporation and by-laws. The board of directors strongly recommended approval of an increase in the firm's capitalization from 1.5-million to 3-million ten-cent par shares "in order to meet the needs of the company for its continued and anticipated growth." Another proposal permits the company to grant stock options to key employees as an inducement to enter five-year employment contracts with the company. Other suggested changes would enable the company to broaden the scope of its operations, provide for enlarging the board of directors from five to fifteen members, move the head office from Yakima to Spokane, and extend the corporation's existence from its present expiration date in 1968 to perpetuity.

American Smelting and Refining Co. has concluded a contract with the Defense Minerals Exploration Administration for a $660,206 lead-zinc exploration project in the eastern portion of its big Page Mine in the Coeur d'Alene District west of Kellogg. Principal feature of the "East Page" exploration will be an east lateral from the 3,070-ft level of the main Page shaft for a distance of 5,720 ft into a virtually unexplored area between the Page and Bunker Hill Mines. The contract provides for a total of 12,785 ft of drifting and crosscutting, with an allowance for drifting on any mineralized structures that may be encountered.

East lateral was started in mid-October on a one-shift basis, but will be stepped up later. It is estimated that the entire project will take about five years to complete.

At Asarco's Morning Mine near Mullan, development work on the new Noonday orebody, discovered last December, is continuing to show encouraging results. A second raise from the 1250 level, where the ore was first opened, is now in progress and drift headings are also underway on both the 1050 and 1450 levels, all in good ore. Diamond drilling has disclosed equally good values at the 850 horizon and a crosscut to open this area is in progress. About 2,000 tons of development ore were milled recently at the Golconda custom concentrator.

Why the LINK-BELT Series 100 is

TODAY'S MOST WIDELY ACCEPTED BELT IDLER

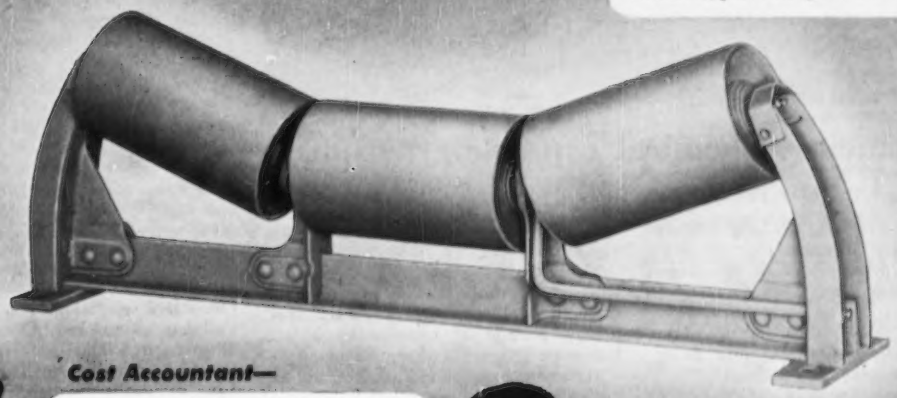
Here's what men who know idlers have to say

Superintendent—

"Service records of the Link-Belt Series 100 belt conveyor idler show that there's no more durable belt conveyor idler in the capacity range. It's a 'work horse'—gives economical service under hard duty, conveying all but the heaviest and coarsest materials."

Engineer—

"Look at these design features. Self-contained, concentric rolls with bearings fully enclosed and protected . . . strong heavy ribbed brackets and sturdy rigid frames maintain accurate roll alignment—won't spread under load . . . hex nuts that lock rolls in brackets, preventing shaft rotation."



Cost Accountant—

"All costs considered—installation, operation and maintenance. You won't find a better buy in belt conveyor idlers than the Link-Belt Series 100. Its free-rolling action requires less power . . . reduces wear on operating parts and belt . . . cuts replacements."

Maintenance Man—

"Its cartridge seal is the best I've seen . . . has no springs, clips and other small parts to lose . . . cuts servicing time when required. It's tops for keeping grease in, dirt out under the grimiest conditions. Grease fittings are protected, easy to reach."

Broad range of types meets all material and operating requirements

RUGGED . . . free-rolling . . . dirt- and dust-proof—the Link-Belt Series 100 belt conveyor idler combines these and other features for low-cost, dependable materials handling under severe, continuous service conditions. What's more, you have a wide choice of types for any requirement—whether you handle coal, sand, gravel or iron ore . . . sticky or free-flowing materials.

Sturdy rolls of the Series 100 are accurately machined for concentricity—welded for added strength and to keep out dirt and moisture. Smooth, round surfaces and edges prevent belt damage. As for dependability of its roller bearings—Link-Belt has *never* known a bearing failure due to overloading a Series 100 idler. Equally important, strong malleable iron brackets and sturdy, rigid frames maintain accurate roll alignment.

For facts on the Series 100 belt conveyor idler, see your nearby Link-Belt office or authorized stock-carrying distributor. Or write for Book 2416.

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AT INAUGURATION of Anaconda's new Chilean copper mine, La Africana, board chairman Roy H. Glover addressed dignitaries including Carlos Ibanez, President of the Republic. Santiago Mining Co., Anaconda subsidiary, will operate the mine, parts of which (concentrating plant and mine head frames) can be seen in the background. La Africana's orebody, reported to contain 3-million tons of 2.25% Cu sulphide, is located just 10 miles from the capital city of Santiago.

San Francisco Chemical Taps Utah Phosphate

STAUFFER CHEMICAL CO and affiliated San Francisco Chemical Co. are going ahead with development of the largest phosphate rock deposit in the western hemisphere.

Project's extent still depends upon several "unknowns" which must be resolved in the next 12 months.

But commencement of exploitation of the 700-million ton Humphreys deposit 15 miles north of Vernal, Utah, which San Francisco has under option, will begin, at least on a custom rock shipping basis.

Stauffer and its 50% owned San Francisco Chemical of Montpelier, Idaho, already have resolved methods of mining and rock handling for the deposit.

Research is under way on providing a satisfactory supply of "carbon" for use in electrical furnaces.

The companies, having abandoned hope that a spur line of the Denver & Rio Grande Railroad Co. might be built into the area, are completing economic surveys on truck haulage out of the non-rail-connected, sprawling Uintah Basin of eastern Utah.

Elwood I. Lentz, vice president and general manager of the Stauffer-controlled fertilizer producing Western Phosphates, Inc., Garfield, Utah, says electrical power for an elemental phosphorus furnace is still an unknown factor. However, Stauffer is entering the elemental phosphorus field, Mr. Lentz stated.

The project calls for San Francisco Chemical to handle mining and beneficiation of the 21 (medium grade) phosphate rock in the Humphreys deposit which lies astride the road between Vernal and Manila in Daggett County, Utah.

Stauffer would build electric furnace capacity

Minimum economic size of the furnace would have to be 22,000 kw. A much larger or additional unit is programmed if this portion of exploitation of the vast rock reserve is achieved.

Here is the run down to date on the big project:

The mine: Enough ore to take care of all the demand for rock in the United States for at least 25 years.

Can be operated as very low-cost open cut mine.

San Francisco has completed extensive and successful up-grading of the ore. This process is now operative at Leefe, Wyo., concentrator where San Francisco mines an orebody owned by Stauffer.

Large volume shipments will be made from the mine in 1958 to Leefe, testing both process in volume treatment of Humphrey's and economics of truck haulage.

There is ample water in area for ore beneficiation at deposit. It is planned to mine at initial rate of 2,000 tpd or more than 800,000 tons annually.

Rock would go to custom users for direct application to soil: upgraded rock to Western Phosphates for use in treble superphosphates, ammonium phosphates and new nitrogen-phosphate-potash blend Western has programmed; up-graded rock to elemental phosphorus furnace.

The furnaces: Electrical power would come from lines of Utah Power & Light Co. connecting at Castlegate, Carbon County, Utah mine-mouth plant of UP&L or from Flaming Gorge Dam, 20 miles north of mine now under construction by U. S. Bureau of Reclamation.

The private utility power service survey is under way. Any purchase of power from Reclamation would have to await commitment decision, which is a number of months away but which must be made in 1958, observers say.

Power available to competitor element phosphorus producers in Idaho-Montana area is between 3.8 to 5.5 mills. Power from Flaming Gorge or UP&L will not be "cheap."

Carbon: There's coal on the property which could be used. Gilsonite can be mixed with coal. Some coking coal may be available from integrated steel industry in Utah.

Market: westcoast and back east to Missouri River. This is basically market that Western Phosphates ships to right now in its treble super sales program.

Employment: 500 persons.

Cost: Eventually up to $20-million.

Idaho *(Continued)*

Black Bear Silver-Lead Mines Co. has opened three feet of good lead-zinc ore in the "by-pass" tunnel it is driving around a caved area in the easterly part of the main Black Bear adit in the Burke Canyon northeast of Wallace. The new hanging wall structure consists of numerous stringers over a 3-ft width, some of which are clean galena. Further exploration of the discovery will be undertaken as soon as the by-pass is completed.

Initial deep exploratory drilling tests carried out during the past summer by Pinnacle Exploration Inc., subsidiary of Callahan Zinc-Lead Co. and Vulcan Silver-Lead Corp., on the big property of Uranium Mines Inc. east of Mullan have accomplished their two-fold objective of supplying geological data and establishing the presence of both the Snowstorm and Silver Cable structures beneath Uranium Mines' ground. Both structures were penetrated at a depth of more than 500 ft. No ore was encountered at that horizon, but it is known that both are favorable to ore deposition, having yielded some production in the past on adjoining properties.

Bunker Hill Co., Kellogg, has bought the Red Bird lead-silver mine near Clayton, from Louis Buchman, Salt Lake City, and partners.

Amount of transaction was not disclosed.

Mr. Buchman purchased, personally, the properties in 1946 from the Ford Motor Co., which in 1920's had developed the Red Bird orebody in order to provide a domestic supply of lead metal for batteries in Ford cars.

Shortly after acquisition, Mr. Buchman, a retired vice president of Kennecott Copper Corp., associated L. S. Breckon, Salt Lake geologist and J. A. Nornden, then manager of National Tunnel Co., Salt Lake City, in the project. Mr. Norden became operating manager of the Red Bird.

Bunker Hill is now engaged in a detailed geological reconnaissance of the Bay Horse mining district.

SEVEN SIZES—½ to 50 HP—420 to 5 rpm—single and two double reduction ratios. Output torque ratings up to 31,500 lb-in.

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Wherever you require a highly efficient, economical speed reducing unit to fit into a limited space, the FALK All-Steel Shaft Mounted Drive meets your needs perfectly. This rugged, compact reducer mounts directly on the driven shaft and is driven through V-belt or chain drive from any convenient rotating power source.

It's hard to match the versatility of a Falk Shaft Mounted Drive. You can choose a single or double reduction unit and use it with any of the many possible sheave or sprocket ratios to obtain almost any specified speed between 420 and 5 rpm. Equally important, the standard Falk Shaft Mounted Drive is available for horizontal and vertical application. Delivery is immediate, installation is quick and easy.

These units are completely FALK-designed and FALK-built for a long life of dependable, trouble-free service. *Precision-cut helical gears of highest efficiency* are employed for efficient, quiet operation.

Always available promptly from factory and distributor stocks, from *coast to coast*. For details, ask your Falk Representative or Distributor—or write for **Bulletin 7100.**

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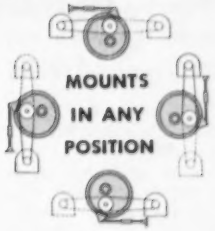

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OVERLOAD RELEASE that will slacken belts and cut off power if overload occurs

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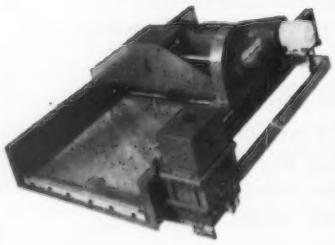

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Idaho *(Continued)*

Mr. Buchman said it was understood that the new operators would sink shaft below 900 foot level in exploration program at the Red Bird.

Northwest Prospecting and Development Co., of Spokane, announced it has shipped its first 2,000 lb of thorium concentrates. The concentrates were produced from ore mined at the company's Hall mountain property near Porthill, Idaho.

The ore came from a hillside vein and was trucked to the J. D. Drent tungsten mill at Hall, Mont. Officials of Northwest said the mill successfully concentrated the ore with only a few equipment adjustments. Plans are being considered for moving the mill to the north Idaho thorium property if sufficient purchase orders for the concentrates can be obtained.

Northwest Prospecting and Development Company was organized last year to develop thorium and uranium showings on Hall mountain.

ILLINOIS

Extensive search for new fluorspar deposits is presently under way in the Hardin County mining area. Two geologists, F. B. Kern, representing Union Carbide Nuclear Co., and James B. Lee, of Kaiser Aluminum Co., are making exploration surveys. Kern has headquarters at Rosiclare and Lee, at Eldorado.

Tamora Mining Co. recently started exploratory drilling for fluorspar on the Joiner property in Hardin County, according to Wiley Cochran, of Elizabethtown, company president and owner. The property, under lease to Tamora, lies south of the Jefferson fluorspar mine in the southern section of the county.

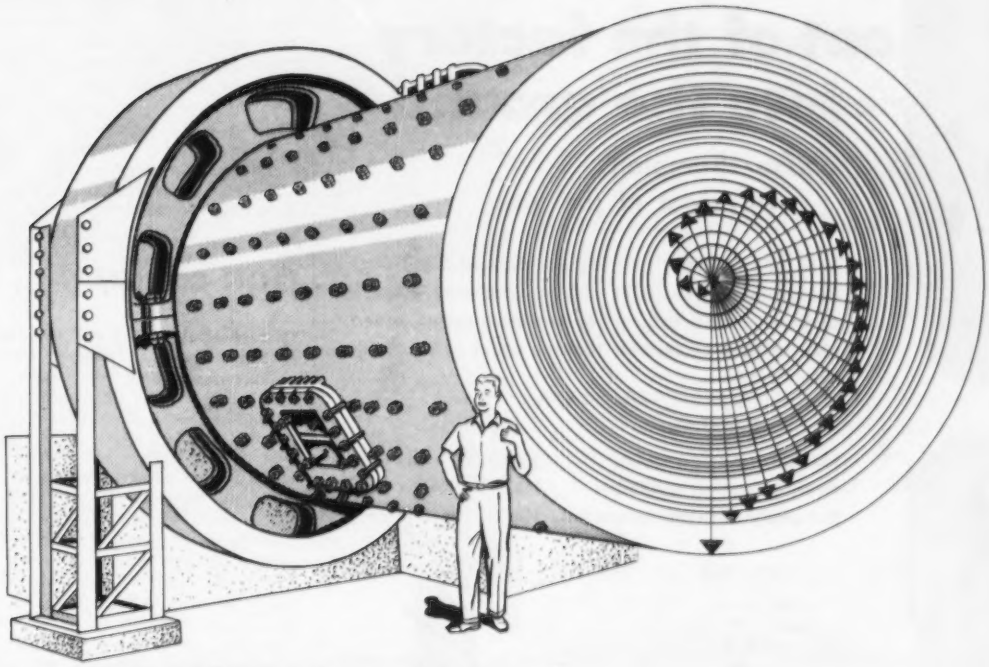
The problem of finding new ore reserves in the Kentucky-Illinois mining district is the most serious confronting the industry, according to Chester W. Shaw, of Rosiclare, Alcoa geologist, in a discussion of problems associated with the area's fluorspar mining before the Society of Mining Engineers and Southeastern States Mining Conference at Tampa, Fla., in October. Companies of the district are beginning to accelerate exploratory programs, he said, but discovery of hidden orebodies is a slow and difficult process. The finding of new reserves is not keeping pace with the demand for finished fluorspar.

Sale of the Mackey-Humm Mining Co. and a controlling interest in the Hicks Creek Fluorspar Mining Co. to Cummings and Roberts, of Darby, Mont., was announced Nov. 7 by H. Evan Roberts, Montana mine operator. The new owners took over operation of the Hardin County properties on Nov. 15.

The transfer represents the first major entry of new interests into the Illinois fluorspar district in the last ten years. Mackey-Humm has operated in Hardin

Marcy Mills

29 *different diameters*



not on the drawing board, but *operating* and *proved* in the field!

Marcy engineering, experience, and flexibility have been **field proven** in 29 different diameter mill sizes, from 12″ to 12′-6″ inside diameter, each individual mill made in proper length for work intended. Marcy leadership in developing larger and larger diameter mills accounts for this wide range of sizes. And, experience gained from the design, manufacture, **and field operation** of many mills in each size has resulted in standard mill designs, backed by **field-proven performance** . . . all available to you at no premium price. There's no need for you to experiment with unproven mills.

Small or large, all Marcy Mills incorporate the same experience and proved performance . . . and, regardless of the size mill you require, Marcy's extensive manufacturing facilities assure you that it will be properly and most economically built.

Marcy Mills are available in the following types: Open End Rod Mill, Grate Discharge Ball Mill, Overflow Ball Mill, Center and End Peripheral Discharge Rod Mill Tube Mill, Pebble Mill, Acid Proof Mill, Batch Mill.

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Problem	Solution
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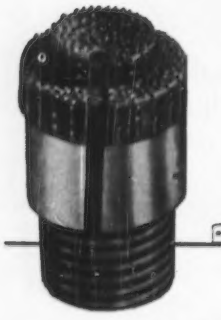

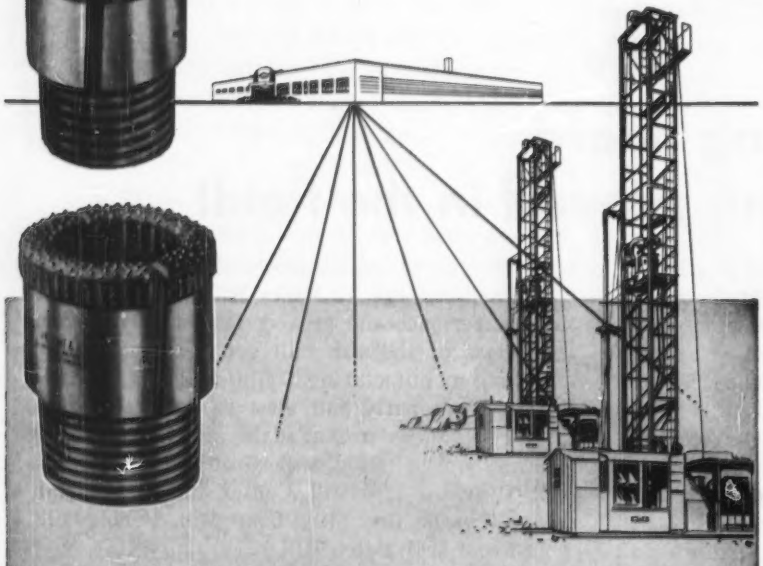

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Illinois *(Continued)*

County for 20 years and Hicks Creek, the last 10 years. Heavy media and flotation equipment was installed at the properties in recent years.

Plans for the Illinois operation call for expansion of acid grade production. Managerial and technical personnel of Cummings and Roberts was sent to the new site from Montana headquarters, but all local mine employees will be retained.

Roberts is owner and operator of a metallurgical-grade fluorspar mine in Montana which records production of more than 60,000 tons a year.

IRON COUNTRY

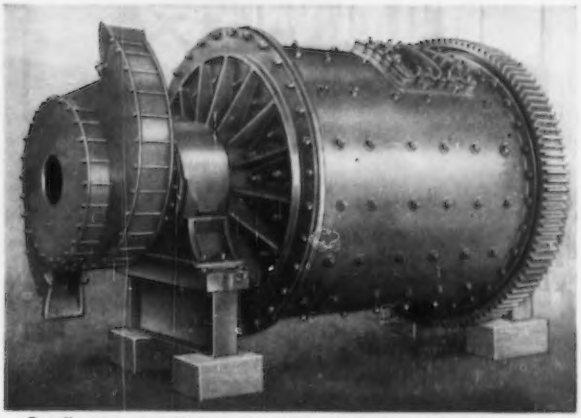
Reserve Mining Co.'s new taconite docks at Silver Bay had shipped about 4.2-million tons of pellets by mid-October of this season. The season's shipments should reach 5-million tons.

One of the earliest ore carrier lay-ups in the history of Duluth-Superior harbor began in October. U. S. Steel's Pittsburgh Steamship Division sent the William B. Schiller to the Knudsen shipyard at Superior for hull repairs; and Buckeye Steamship Company's Princeton and Andrew S. Upson are laid up for the season. Twelve other vessels have been laid up at lower lake ports. Ore shipments have decreased unseasonably and an earlier than usual season ending is predicted with a total of over 79-million tons.

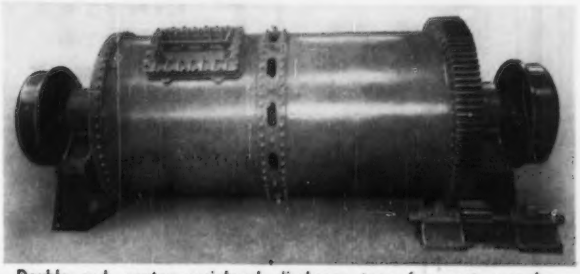
Canton mine of Oliver Iron Mining Division made its last shipment of ore in early October. The mine, among the very early ones, was opened in 1893 by the Minnesota Iron Co. and produced over 8½-million tons. The 250 employes were transferred to other Oliver operations and equipment dismantled for use at other eastern division mines.

Taconite railroad taxes for the first half of 1957 were $159,929: $51,015 more than for the same period last year. The entire amount came from Reserve Mining Co. One half of the taconite railroad tax money goes to the school districts. The tax applies only to taconite processing companies that own and operate their own railroads, is based on production and takes the place of property taxes on the railroad. Erie Mining Co. may come under the provisions of the law for the second half year.

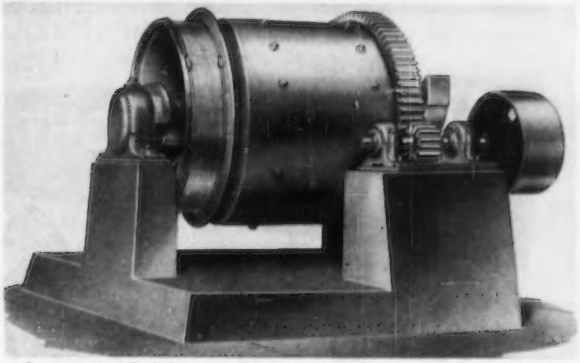
Stripping at the Musser mine of M. A. Hanna Co. on the Cuyana range began March 19 and has been carried on principally by the dragline-conveyor system. The two-man-crew dragline is a 7W with a 7 cu yd bucket and an 185 ft boom. It is the "walking" type. The operation includes a portable hopper and a 1350 ft long, 30 in. wide conveyor belt and a stacker which is on cats. Stripping averages 85 ft in depth. The dragline-conveyor will handle about 53% of the stripping; dragline-truck



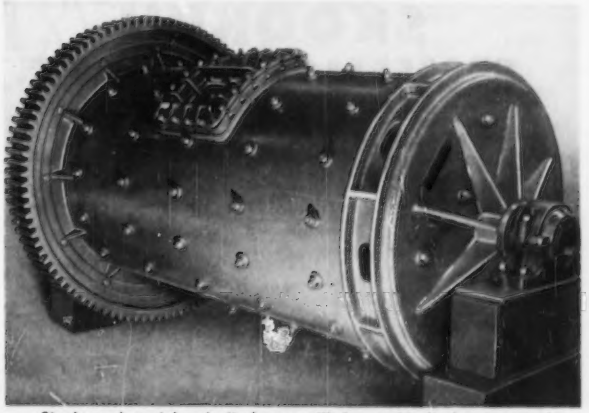
Overflow or grate discharge type flanged to permit extending length.



Double end, center peripheral discharge type for most granular product with minimum amount of fines.



Screening mill delivers a sized product. Unequalled for producing granular product within the limits of screening.



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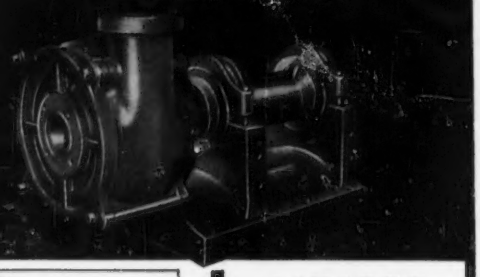

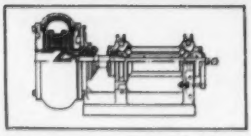

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U.S.A. CANADA

Iron Country *(Continued)*

about 18% and the balance by casting. The mine is expected to be ready for shipping in early 1958.

Jones & Laughlin Steel Corp. has finished its summer diamond drilling program on optioned iron ore lands in Quebec, about 180 miles north of Seven Islands. The drill cores will be studied this winter and drilling will probably be continued in 1958.

On Oct. 25 Reserve Mining Co. closed its Babbitt pellet plant which has a capacity of 300,000 tons per year. About 140 men were laid off. With the assistance of Reserve most of these men have found employment at other properties, chiefly Erie Mining Company's plant at Aurora. Reserve's taconite pits at Babbitt, the crushing plant and railroad shops, employing over 1,000 men, will continue to operate as will the large plant at Silver Bay.

Robert J. Linney, vice-president in charge of Reserve's operations, said this plant can turn out 5-million tons of pellets a year, which is enough to supply the requirements of Armco Steel Corp. and Republic Steel Corp.

United States Metals Refining Co. is continuing its diamond drilling program on copper formation lands north of Wakefield and 20 miles west of the White Pine copper mine. It expects to keep drills working on the property through the winter.

Republic Steel Corp. closed the 57-year-old Tobin mine at Crystal Falls for an indefinite period. F. H. Cash, Duluth, manager of Republic's northern ore mines, said the mine is being closed temporarily "because of economic conditions." He said it was not possible to tell when the mine would resume production. Of the mine's 185 employes only a skeleton maintenance crew, including pumpmen, will be kept on. The Tobin, originally a Corrigan-McKinney Steel Co. property, was taken over by Republic in 1935 by merger. An underground conveyor system was installed in 1947.

Ashland Mining Co. has announced that it may build a plant in Ashland county, Wis. which would employ about 500 men. President William B. Cudlip of Detroit said that tests prove a sufficient tonnage of iron bearing material exists on its mining properties there to make a mine and concentration plant economically feasible; but further studies will be conducted. Preliminary work is being done on designing a concentration plant and other mining facilities for the production of 1½ million tons of pellets per year which should average 62% in iron. McLouth Steel Corp. of Detroit owns a one half interest in the company.

Cleveland-Cliffs Iron Co. has reduced production at six of its eight Marquette range mines by going to a four-day, 32-hour week schedule, beginning on November 3. The company announced that their iron ore stockpiles were ab-

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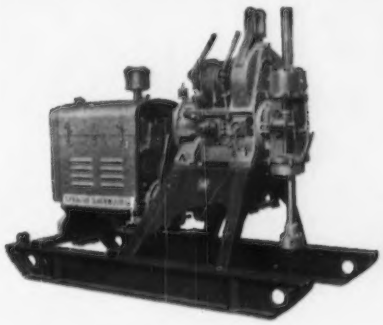

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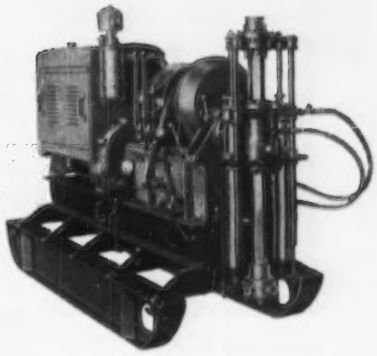

Yes . . . if you need a small one or a heavy one we have just the core drill machine for you. Manufactured by us and used in our own contract drilling department they are made to operate efficiently under the most difficult conditions, giving you the utmost in performance. Write today, giving full details and a descriptive folder on the proper size will be sent. (Skid mounted, trailer mounted, truck mounted.)

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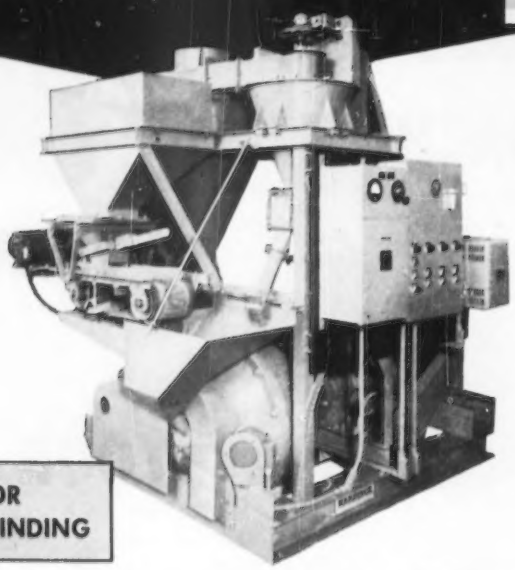

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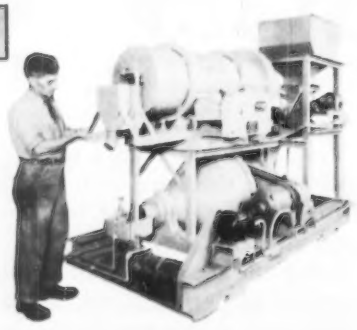
For any small-scale continuous dry grinding or pulverizing problem (such as is found in a pilot plant, laboratory or small commercial process) the Hardinge dry grinding unit is the solution. Completely self-contained and portable, this unit requires only power connections to be placed in operation. Includes Constant-Weight Feeder, "Electric Ear" grinding control, Conical Mill, "Gyrotor" Air Classifier, product collector and dust collector.

FOR WET GRINDING

Hardinge builds a similar unit (right) for small-scale wet-grinding applications. The "package" includes mill, classifier, feeder, "Electric Ear", and launders.



Bulletin AH-448-1

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Iron Country *(Continued)*

normally high. The shorter week, affecting 2,000 employes, was adopted to avoid layoffs.

R. T. Elstad, president of U. S. Steel's Oliver Iron Mining Division, estimates that Oliver's shipments this year will be in the neighborhood of 34.5-million tons of iron ore and concentrates, which will exceed last year by about 4,000,000 tons.

High grade iron ore concentrates produced from low grade ores and taconite accounted for approximately 6.9-million tons of Oliver's 1957 shipments.

"We have had a busy season," Mr. Elstad said, 'and plans are being made for an active program of winter work to get our mines, plants and equipment ready for 1958 production." A high level of employment among Oliver's 6,700 miners will be maintained this winter.

Missouri's Iron Pits Start Volume Output

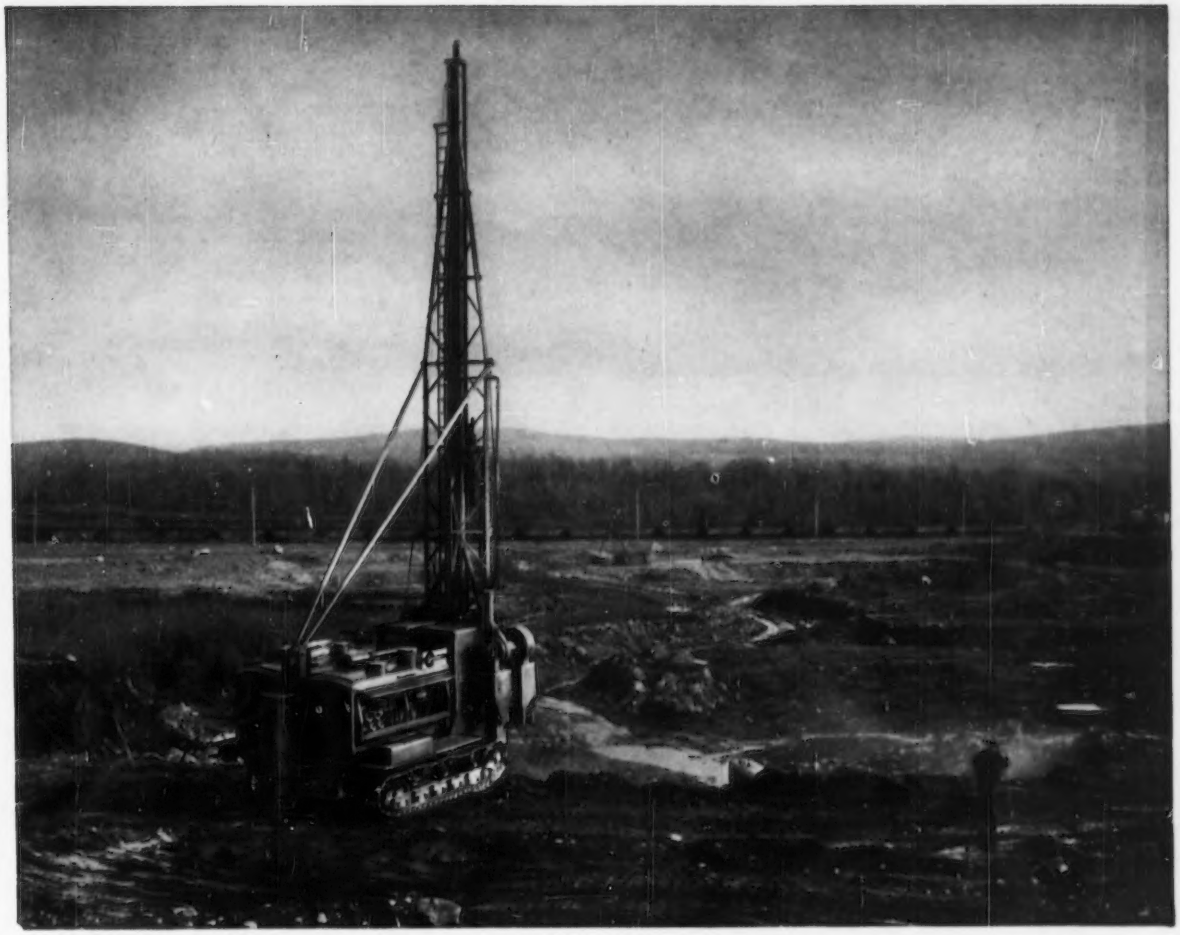
IRON MINING in Southern Missouri is now being feverishly undertaken by a group of small, open pit operators.

Reasons for the present boom are (1) demands created by the steel industry's expansion, (2) accessibility of Missouri deposits to steel mills of the South and Midwest which previously had looked to Canada and South America for fresh sources of supply, (3) fact that the Missouri ore, though high in impurities, has low phosphorus content which, when blended with ores from other ranges, reduces the over-all phosphorus content at the mill. (See photos on p 198.)

MONTANA

National Uranium Corp's No. 1 tunnel has reached the vein objective at its Lucky Joe uranium property on the West Fork of the Bitterroot River in Ravalli County. The uranium-bearing phyllite vein was first opened in a raise about 12 ft above the tunnel and it registered a maximum reading on the second scale of the scintillator at the point of intersection. Chemical assays had not been completed at the time of this writing, but the raise was being continued upward on the vein and development ore was being stockpiled at the tunnel portal.

Merger Mines Corp. and St. Paul Lead Co. have nearly completed installation of a new 100-ton flotation concentrator at their old Snowshoe Mine, a joint venture operation, in Lincoln County near Libby, and expect to be in production in the near future. Some 12,000 tons of ore—enough to keep the mill in operation for about five months—are now available in the mold workings, and samplings indicate an average metal content of 15.3% lead, 6.3 oz of silver, 4.3% zinc and 0.04 oz of gold per ton. It is estimated that this ore will yield the



Highly maneuverable, the self-propelled Ingersoll-Rand Quarrymaster is powered by two 415 cfm heavy-duty air compressors. In only minutes it moves from one hole to the next on air-operated tracks.

Nickel alloy steels help Quarrymaster drill blast holes that speed-up output

Operators of this open pit mine in upper New York State save time, sink fewer blast holes, and yet substantially step-up ore output of the property.

The Quarrymaster puts down large diameter holes thus making it possible to drill them much farther apart, center-to-center, and still secure equal or better fragmentation than conventional drills which put down a closer pattern of smaller holes.

Heat-treated nickel alloy steels help the Quarrymaster drill up to a 6" hole at a rate of 10 or more feet per hour in the hardest rock . . .

And in relatively soft rock it sinks holes at rates up to 80 feet per hour. The heart of this Quarrymaster is an air-operated piston drill, employing hard, tough nickel alloy steels for vital parts.

Take its nickel alloy steel piston, for example. This part withstands continuous brutal battering by a tremendous load of more than 200 heavy blows per minute.

Rifle bar and other components, likewise are made of nickel steels to withstand correspondingly tough operating conditions.

Where use means abuse . . . as in the Quarrymaster . . . you can improve specific properties in many metals by alloying with nickel alone or in combination with other alloying elements. Send us details of your metal problems . . . we'll be glad to help you with suggestions for your specific applications.

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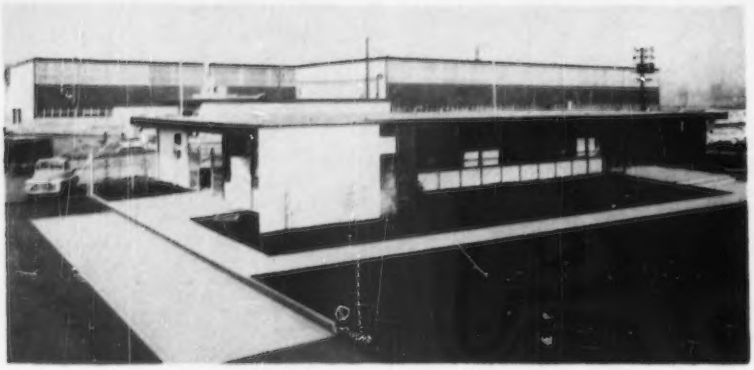


FROM this new brass plant, Titan Metal plans faster delivery to western clients.

First Northern California Brass Mill Opens

YEARLY MILL OUTPUT of 25-million lb of brass and bronze products will be the eventual capacity of Titan Metal Manufacturing Co.'s new plant at Newark, Calif.

The $3-million unit, recently visited by Chester D. Tripp, Titan board chairman, is the first of its kind in this area and is housed in three buildings covering a total of 89,300 sq ft on a 40-acre site southeast of Newark.

Machinery at the new Titan plant will include four 180-kilowatt electric induction furnaces, heavy forging presses of 150-ton and 1,300-ton capacity, and an extrusion press weighing 139 tons and capable of exerting 1,850 tons pressure.

Montana *(Continued)*

companies a net profit of about $200,000 before taxes and royalties. Probable ore reserves in the mine are estimated at 270,000 tons.

Stockholders of Montana Standard Mining Co., Ltd., have approved and ratified a contract with Hecla Mining Co. under which Hecla has taken over exploration and development of the old Montana Standard lead-zinc property on Prospect Creek in Sanders County. Initial exploration will be a four-hole diamond drilling program on the main adit level, and preparation of drilling stations is already in progress. The contract gives Hecla an option to acquire a 50% economic interest in any ore production or to purchase the property outright for $300,000.

NEVADA

Formation of the Yale Gold Mining Co. to reopen the old Elko Prince properties in Elko County, was announced at Salt Lake City by W. H. H. Cranmer.

New Park Mining Co. and East Utah Mining Co. are putting up the money for the program, said Mr. Cranmer. He is president of New Park.

Men are now at work driving a 600 foot tunnel from the adjoining holdings of Miners Gold Mining Co. into the main workings of the Prince.

Yale has a 20 year lease and option to acquire the Elko Prince. At time of shutdown several years ago, due to caving of the main shaft and water flow, the Elko Prince had a "substantial quantity" of ore amenable to mining at $35 an oz for the metal, Mr. Cranmer said.

A principal reason for the program, however, is his belief that ultimately the U. S. Government will be forced to raise the price of domestic gold in order to bolster deficits in gold reserves held by Allies in western Europe, Mr. Cranmer said.

Minerals Materials Co. during October started operation of a new magnetic separation plant at its mine 30 miles east of Lovelock. It handles 300 tons per hour and crushes the ore as well as concentrating it by the use of powerful magnets. Trucks from the mine dump the ore into a hopper from where it is conveyed to a five-inch jaw crusher. It then passes over a 30-in. drum magnetized by direct current to which the ore clings. Rock that was not attracted to the magnets is then crushed to a fine of one-eighth inch and passed over another separation unit. Power is supplied by three AC generators run by diesel motors. A rectifier is used to convert the current for the magnets. Ore is hauled by trucks to Colado where it is placed on Southern Pacific cars. Shipments up to now have been to Japan, but the new upgrading plant has been installed to make the ore salable in domestic markets due to the fact that the Japanese demand for ore has been slacking off and fluctuating to a large degree.

N. C. Baxter, mining engineer who is making his headquarters in Lovelock, is developing a large deposit of argillaceous limestone in Pershing county, and plans to build a cement plant at Lovelock to treat the output. Production is expected to be 250 barrels of cement daily. The deposit is 12 miles east of Lovelock and consists of six claims totalling about 960 acres. Facilities for loading the cement at Colado, six miles east of Lovelock, are being sought from the Southern Pacific Co., according to Baxter.

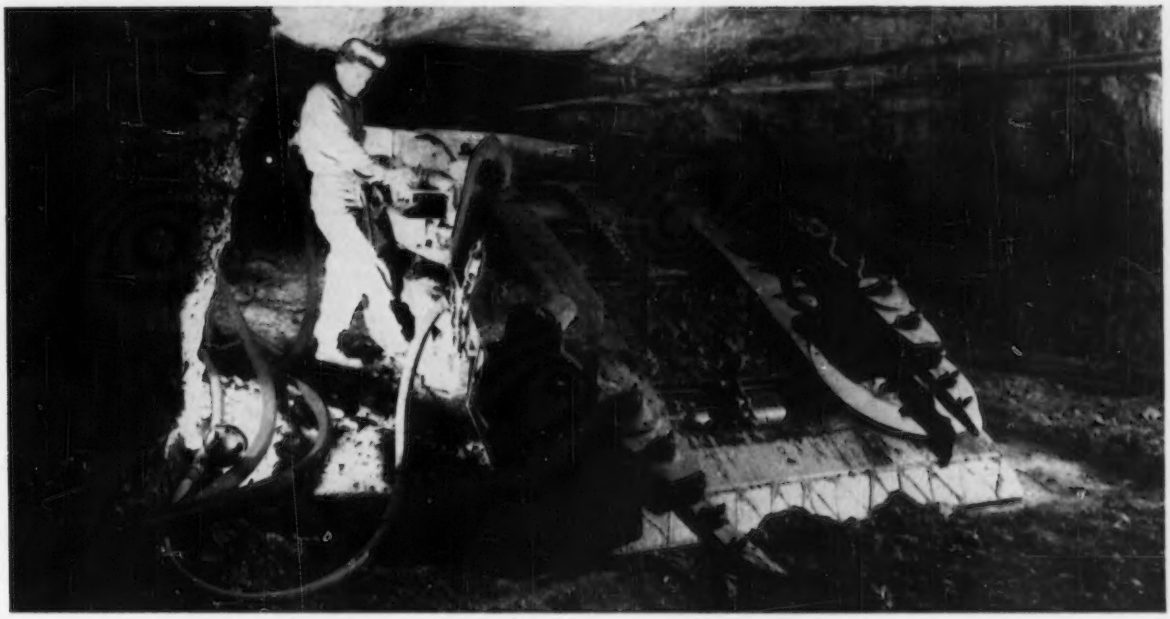
Eagle Picher Co. has let the contract for planning and construction of their new mill at Colado to Kaiser Engineers, of Oakland, Calif., according to Glen J. Christner, vice president and general manager of Eagle Picher. The Colado site is east of Lovelock on the Southern Pacific mainline and consists of 63 acres. Sierra Pacific Power Co. and Bell Telephone Co. lines run near the site, and water is being provided through agreement with the City of Lovelock. The plant is expected to go into operation by August 1958, and will process diatomaceous earth from Eagle Picher's property 20 miles west of Lovelock consisting of about six square miles. A new road will be constructed to join the mine and mill sites. No cost estimate of the new mill was announced. The construction will be Eagle Picher's second diatomaceous plant in Nevada, the present one being at Clark Station 20 miles east of Sparks.

Chickbed Co., which has a diatomaceous mine near Brady's Hot Springs in Pershing county, and a mill at Fernley, has entered into contracts with the DuPont Co. and the Monsanto Chemical Co. to furnish them with filter material, according to Otto Kohl, of Cedar Rapids, Iowa, president of the firm. The mining property in Pershing county is said to contain 25-million tons of filter quality earth. It is moved to the mill at Fernley by truck.

Erection of a new ore mill at the Bootstrap Mine 30 miles northeast of Dunphy in Lander county has just been completed. Owners of the property, M. S. Fisher and Claude L. Taylor, of Battle Mountain, let the contract for the mill to R. R. Reed and Sons, of Fallon. The mine consists of 20 adjoining lode claims and two placer claims, and the ore is rhyolite porphyry carrying good gold values. The co-owners have been developing the property for the last two years, and have uncovered two orebodies 40 to 50 ft in width and with good depth. Mining will be done by open pit method, and the mill, which uses a cyanide process, went into use early in November. It is designed to handle 100 tons daily, and provision has been made to add more milling units in case developments show they are needed.

NEW MEXICO

San Mateo Dome uranium orebody of Rare Metals Corp. of American contains more than 800,000 tons of ore and the last three holes drilled continue in ore,



LOADING MACHINE, equipped with 500 feet of Y-ground cable. Cable's Y-shaped ground conductor separates three phase-conductors, reducing danger of phase-to-phase faults if the cable becomes damaged.

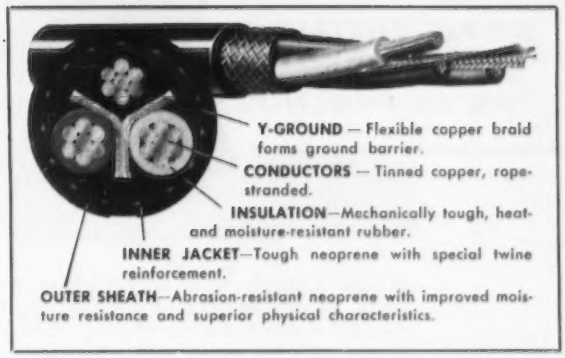
New General Electric a-c mining cable helps prevent phase-to-phase faults

New General Electric portable cable with Y-ground construction is designed especially for use in a-c mining installations on a-c shuttle cars, loaders, and similar equipment. It offers the protection against phase-to-phase faults provided by a cable with a shielded construction without the complications inherent in a fully shielded cable.

The ground conductor is composed of special flat copper braid placed between the power conductors in such a way as to form a "Y." Because of this Y-shape, the ground conductor provides a barrier between the insulated conductors and, thus, helps to prevent phase-to-phase faults (see cross-sectional drawing).

This new General Electric Y-ground a-c mining cable, which carries U. S. Bureau of Mines marking, is easy to maintain and to splice. The braided construction of the mechanically strong and flexible Y-ground conductor provides long service life.

Bend and twist tests on this new cable, performed on a U. S. Navy Flexing Endurance Test machine, showed no damage to conductors even after more than 100,000 cycles. On impact test, using a 23-lb weight and 6½-inch drop, the cable withstood more than 35,000 impacts before failure was obtained. When failure did occur it was from a phase conductor to the Y-ground conductor—confirmation of the soundness of the design and construction.


Y-GROUND — Flexible copper braid forms ground barrier.
CONDUCTORS — Tinned copper, rope-stranded.
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Ask your General Electric representative for complete details about the new G-E a-c mining cable today. And for high-voltage distribution to underground a-c mine load-centers, ask him about G-E Geoprene* Type SH-D and Super Coronol* Geoprene mine power cables with special conductors for ground continuity check circuits. Or write for literature to Section W217-1295, Wire and Cable Department, General Electric Company, Bridgeport 2, Connecticut.

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New Mexico *(Continued)*

according to M. H. Kline, vice president and assistant general manager of the affiliate of El Paso Natural Gas Co.

The ore, which runs .24 U_3O_8, is valued at more than $20 million. San Mateo Dome is southwest of the Ambrosia Lake district in McKinley County.

Kline said that while exploration continues to add to the ore reserves, the firm also was: 1. In tentative negotiations with Atomic Energy Commission on possible construction of a uranium mill and, 2. engaged in engineering preliminary to working out a mining program. The ore would of necessity have to be mined on underground basis as it is between about 750 and 1,000 ft deep.

Banner Copper Mine near Lordsburgh, has shut down operations because of the low price of copper. The shutdown idled 113 of the mine's 138 employes.

A spokesman for the company said the mine had been operating at a loss for the last three or four months and when the price of copper dropped to 26c a lb it was decided to close the mine.

Signing of a $10-million contract for construction of a uranium ore processing mill near Grants has been announced by Homestake Mining Co.

The contract is with Utah Construction Co., San Francisco, which will design and build the mill for Homestake-Sapin Partners, operators of the facility.

In addition to the mill, which will have a 1500-ton daily capacity, Utah will construct related surface facilities and sink several shafts for the mining operation.

Ores from Homestake-Sapin properties and from other producers in the area will be processed by the mill and the uranium concentrates sold to the Atomic Energy Commission.

Utah is presently building a similar ore processing mill near Riverton, Wyo., for Lucky Mc Uranium Corp.

Dysart Mine No. 1 of Rio de Oro Uranium Mines, Inc., in the Ambrosia Lake region of McKinley County has become the second largest producer and shipper of uranium ore in the nation, according to W. Rodney DeVilliers, Rio de Oro President.

The company produced and shipped 80,000 tons of ore from the mine since April 1955, DeVilliers said. Production now ranges from 12,000 to 14,000 tons per month with a five-day work week.

Value of the monthly production coming from 80 separate working faces underground—is approximately $350,000, DeVilliers said.

Dysart Mine No. 1 was the first mine to produce commercial grades and quantities of uranium in the Ambrosia Lake area.

Rio de Oro is affiliated with the Hidden Splendor Mining Co., a wholly-owned subsidiary of the Atlas Corp.

AEC has granted permission to American Milling Corp. of Alburquerque to purchase uranium ore without limitation as to quantity, according to a disclosure by Melvin E. Richards.

Richards is president of American Milling, a Delaware corporation headquartered in Albuquerque, and he is also the President of Yucca Mining & Petroleum Co., Inc., the parent company and major owner of American Milling.

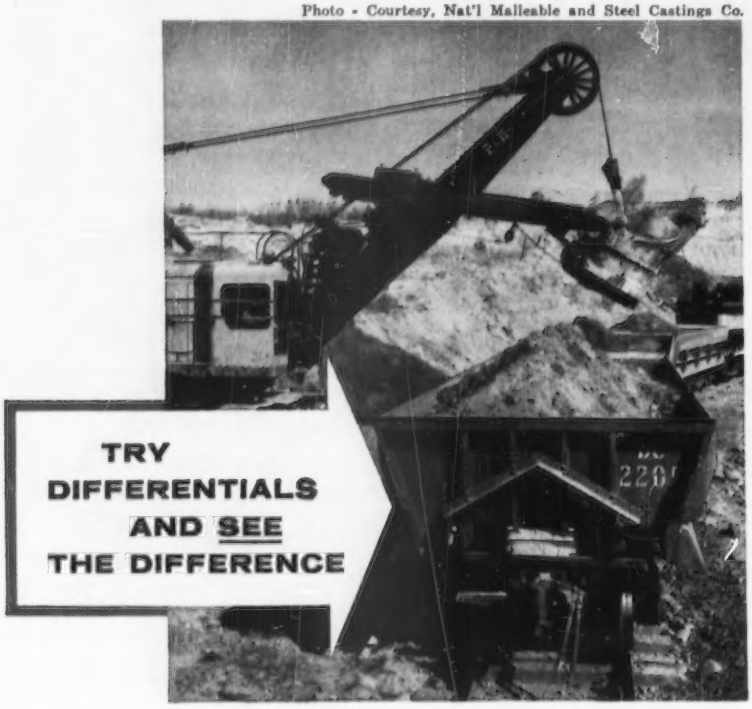
Stockholders of Reserve Minerals Corp. have approved formation of a new corporation whose stock will be distributed to Reserve Minerals stockholders on a share-for-share basis.

The new corporation is Reserve Oil & Minerals Corp. It will receive all the New Mexico properties of Dunn Bros. Uranium Co. in exchange for 100,000 shares of stock in the new firm. The new company will receive claims and interests in the Rio Puerco area—between Albuquerque and Grants, from J. G. Tinkle and W. C. Gilmore in return for 50,000 shares of the new stock.

The firm, headed by Andre Senutovitch, has been expanding its interests in Ambrosia Lake.

Anderson Brothers Corp.'s new manganese concentrating mill, to be constructed on a site 25 miles southwest of Socorro, will be placed in operation the latter part of May according to present plans, Carl C. Anderson, president, announced. The mill will have a capacity ranging from 720 to 1,440 tpd, general Superin-

Photo - Courtesy, Nat'l Malleable and Steel Castings Co.



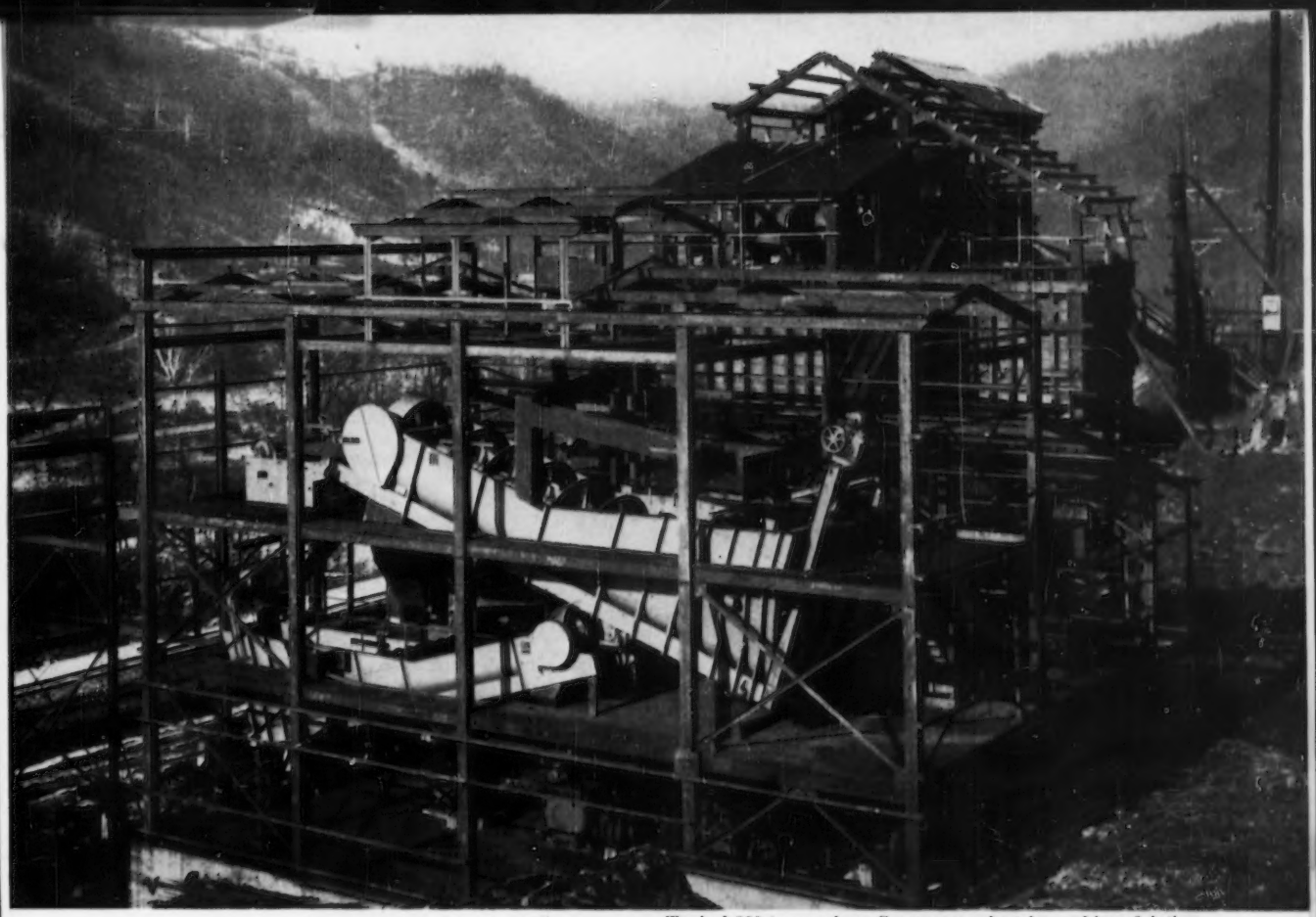
It takes a tough car to take it away, day after day. The many tons of heavy iron ore that fall relentlessly from the shovel demand a car that can take it.

Differential side dump cars — air powered — have been serving the industry for some decades, now, and their performance brings back steady repeat orders that speak for themselves.

Let us send you complete specifications and discuss your needs at your convenience. You'll like what you hear about Differentials.

PIONEERS IN HAULAGE EQUIPMENT SINCE 1915

DIFFERENTIAL STEEL CAR COMPANY
FINDLAY, OHIO



Typical 200 ton per hour SWECO HMS plant for coal beneficiation.

HMS Makes Waste Profitable

SWECO packaged HMS plants pay out in economical, peak recovery of ore and conversion of low-grade materials to profitable products.

Throughout the United States and in mining areas from Norway to Tanganyika, versatile SWECO Heavy-Media-Separation Plants are bringing greater yields to ore and coal beneficiation. These compact plants, with hourly capacities ranging from 10 to more than 200 tons, are profitably treating a wide variety of minerals, including submarginal ores and coals, coarse tailing from past operations, and waste dumps.

HMS Plants built by SWECO's Engineering and Construction Division operate on a sink-float technique, using a fluid medium of finely ground ferrosilicon or magnetite suspended in water. Heavier mineral components sink . . . lighter components float. The valuable middlings fraction between these extremes is recovered. With the Akins Separator – a feature of SWECO HMS plants – virtually all elements of value are recovered and waste is practically eliminated.

How SWECO HMS pays out

In replacing or supplementing more expensive beneficiating plants, SWECO HMS Plants pare down power needs. (A 100-ton/hour plant requires only 85 hp.) They consume little medium, and cost one-fifth to one-sixth as much to build as other units. Simple design and easy accessibility reduce supervision.

SWECO HMS Plants generally become permanent parts of mills, but can be quickly dismantled and reassembled. This makes them ideal for such short-lived operations as processing small deposits, mine dumps, contractors' gravel plants.

Analysis and recommendations

SWECO engineers will analyze your HMS application and provide estimates of operating costs as well as capital investment required. Call or write for information today. Ask for brochure E-8-12.

For more than 35 years, SWECO has specialized in the design and manufacture of *process equipment* . . . and in the *engineering and construction* of refineries, chemical plants and ore beneficiating mills. SWECO also manufactures a complete line of *vibrating screen separators.*

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New Mexico *(Continued)*

tendent Ray C. Wood said. Anderson, whose Mercury Uranium and Oil Co., also headquartered in Albuquerque, is opening up the famous old San Pedro copper-gold and silver mine 35 miles northeast of Albuquerque in the San Pedro Mountains of Sante Fe County, said that the manganese mill will have all new equipment and machinery and will cost approximately $150,000.

NORTH CAROLINA

Lawson United Feldspar and Mineral Co. of Kinpro, near Spruce Pine, has begun shipping from its refining operations. The plant is equipped to refine 8,000 tons of glass grade feldspar, 2,000 tons of low grade iron and glass melting sand, and 400 tons of mica per month.

R. W. Lawson of Spruce Pine is president of the firm, which is owned jointly by Lawson interests and United Clay Mines Corp., producer of clay for production of ceramics, paper, paint and other products.

A new firm, the U. S. Manganese-Sulphate Corp. of Asheville, has been granted a certificate of incorporation by the North Carolina secretary of state. Firm will mine manganese ore and manufacture manganese sulphate from the ore from western North Carolina and east Tennessee.

North Carolina is looking into the possibility of going into the business of mining ilmenite in the sands of the State's sounds if studies show there is enough there to be mined commercially.

A year ago, the state granted two ilmenite leases in the area but since that time has turned down other requests pending more evidence on how much ilmenite the sands bear.

Interest in ilmenite has increased with announcement of plans for construction of a titanium plant at Wilmington and Dr. Jasper L. Stuckey, state geologist, already has made a "general reconnaisance survey" to see how wide an area the ilmenite-bearing sands cover. His next step will be to find out the ilmenite contents of the sands, and he says he plans to "figure out some little device" which will permit him to get samples of the sands at depths of 10 ft under the surface of the sounds. He said the new tests probably will require a year to complete.

Ilmenite leases, effective January 1956, have been awarded to Graham D. Monroe of Coral Gables, Fla., and W. H. Rodenbeck and associates of Ashville, N. C., but it does not appear that the state will award any more until it completes its investigation of the extent of the ore.

OREGON

First diatomite mining operations in Northern Lake County got under way in mid-October when Babler Brothers Construction Co., began stripping overburden to obtain diatomite for testing by Great Lakes Carbon Co. The stripping will soon be completed, according to Bud Pollock of the construction firm, and will require the removal of 30,000 cubic yd. Two Euclid 20-yd scrapers and a D-8 Caterpillar are being used. Hauling to the company's processing plant at Lower Bridge, near Terrebonne, Deschutes County, under way Oct. 21 or 22, Pollock said.

UTAH

Radorock Resources, Inc., Salt Lake City, will not join in merger with other uranium companies controlled by Atlas Corp., because of tax-saving and newly increased ore reserves.

The firm is 52% controlled by Federal Uranium Corp., also of Salt Lake City, which previously had rejected merger offer with Hidden Splendor Mining Co., an Atlas wholly-owned subsidiary.

According to Ralph W. Neyman, president of both Radorock and Federal, "decision to withdraw Radorock from the proposed merger has been reached by the mutual understanding with all parties concerned, including Floyd B. Odlum, president of Atlas Corp."

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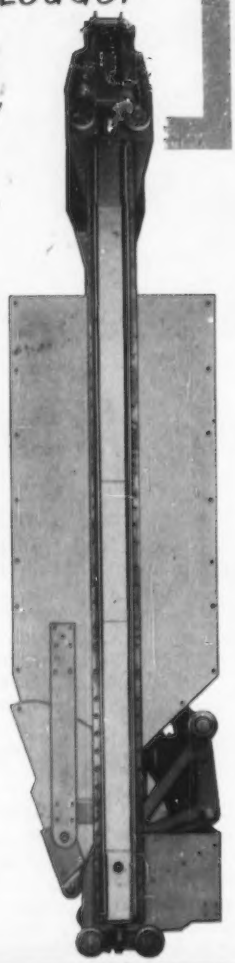

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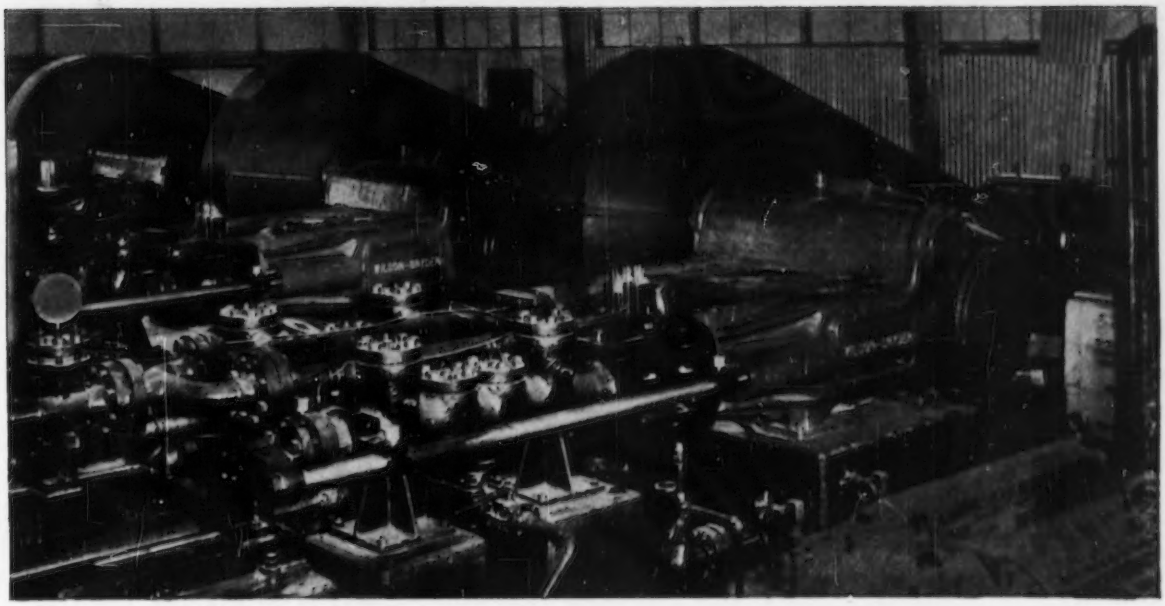

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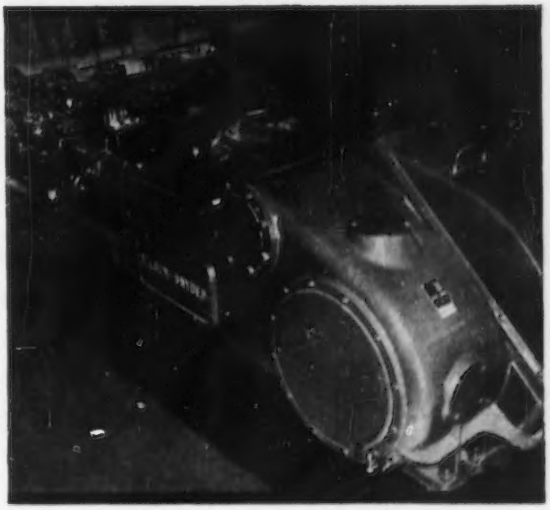

AMERICAN GILSONITE COMPANY'S pumping station at the Bonanza, Utah mines relies upon three (two operating, one stand-by) Wilson-Snyder heavy-duty plunger pumps to move 630 tons of Gilsonite per day through the 72-mile pipeline for processing near Grand Junction, Colorado. Each pump is powered by a 300-hp motor and the system is capable of handling 325 gpm of slurry at 2200 psi.

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Utah *(Continued)*

The proposed merger of Radorock, Lisbon Uranium Corp., also of Salt Lake Cityo Rie de Oro Uranium Mines, Inc., Albuquerque, N. M., and existing Hidden Splendor into a new, publically-owned Hidden Splendor, was announced last August.

Bear Creek Mining Co. has encountered an iron-manganese "shield" in exploration drifting at its Tintic project near Eureka.

Encountering the iron-manganese "show" is regarded as important as most major lead-silver-zinc occurrences in the district are associated with iron-manganese.

New Park Mining Co. has signed contract with E. A. Messer & Associates of Portland, Ore., for 1,000 ft of diamond core drilling on the Lakes Killarney fault in the Ophir District of Tooele County. The firm has obtained operating rights in the area from Silver Shield Mining and Milling Co. and National Treasure Mining Co., both of Salt Lake City.

WASHINGTON

Proposed merger of five Spokane area uranium firms has been approved by boards of directors of each and is pending approval by the stockholders.

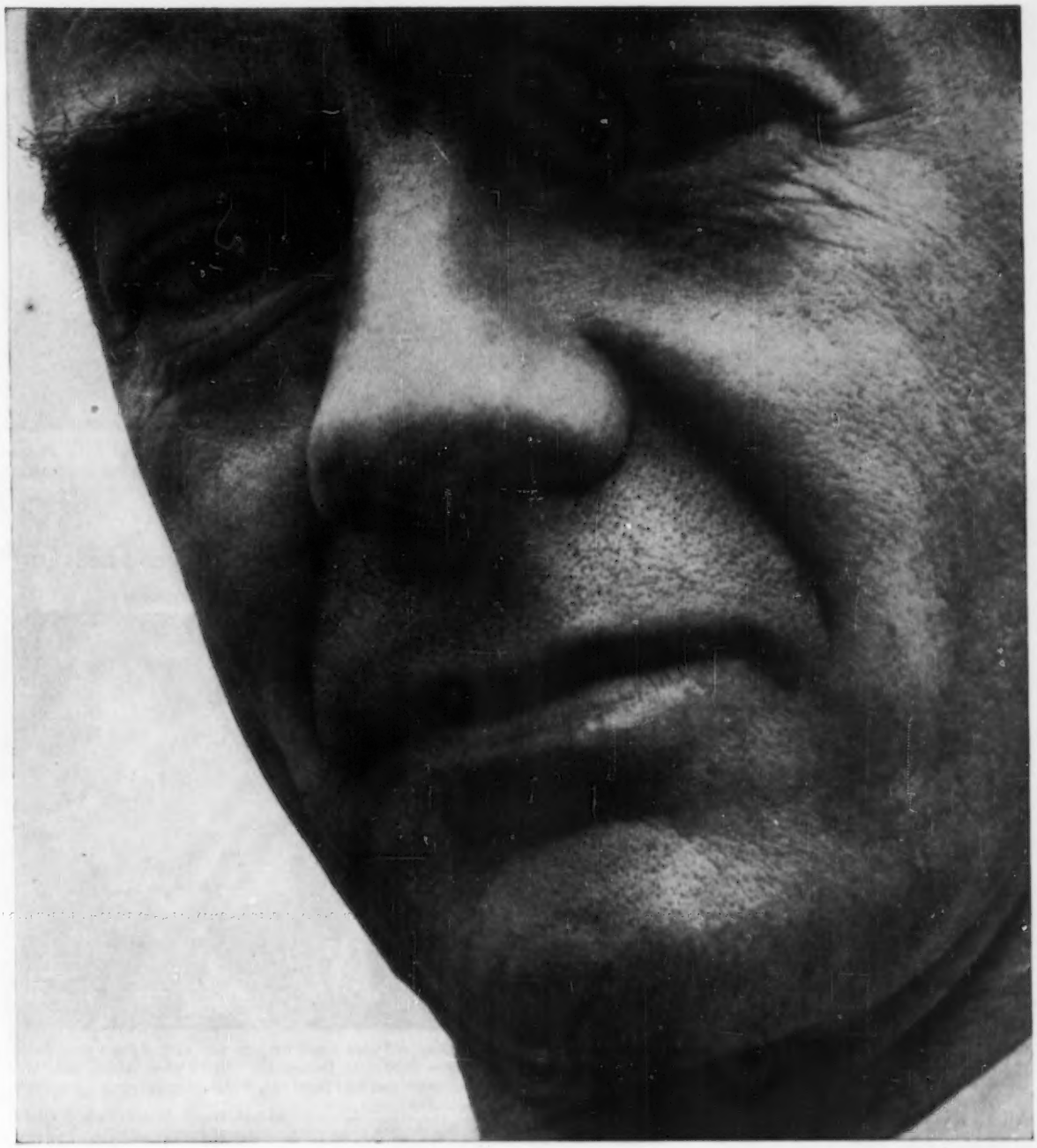
The firms are Dahl Uranium Mines, Inc., Big Smoke Uranium, Inc., Universal Mining Corp., Far West Mines, Inc., and Monida Mines, Inc. Under the proposal, the assets of these firms would be exchanged for stock in Spokane National Mines, Inc., which recently filed articles of incorporation at Carson City, Nev.

Highnoon Uranium Mines, Inc., of Newport, has received a milling contract from Dawn Mining Co.'s new processing mill at Ford, and the firm plans to begin its ore shipments soon.

Clayloon Uranium company officials said they have opened an ore zone on the Huffman lease in the Mount Spokane district. Clayloon, a Spokane firm, started working the property last month under a profit-sharing agreement with Daybreak Uranium, Inc., also of Spokane. A 4½-ft width of ore was uncovered under 10 ft of rock with a bulldozer, according to Byrl T. Goodwin, Jr., Clayloon president.

John F. Campbell, president of North Star Uranium, Inc., of Spokane, said his firm has leased a barite prospect about 10 miles north of Colville.

Campbell said that the barite showings which his company plans to develop are on two tracts of land totaling about 480 acres.



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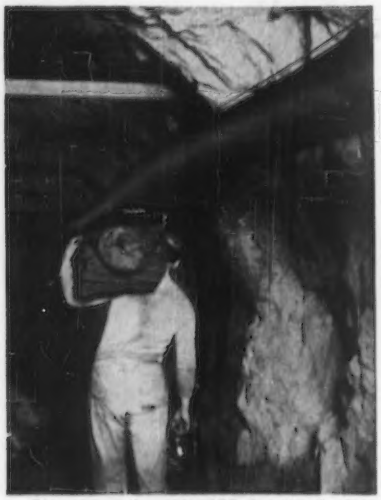

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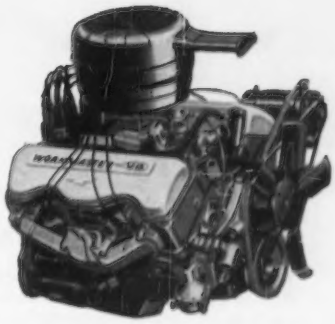

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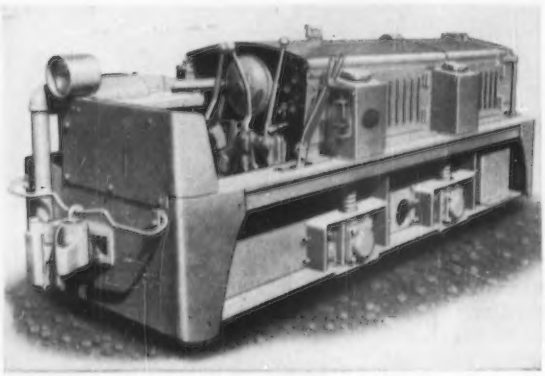

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J1257

Washington *(Continued)*

Spokane Office of the Defense Mineral Exploration Administration said it has approved expenditure of an additional $15,670 at the Scandia zinc project in northern Stevens county.

The money will be used for diamond drilling that will be started next summer. The agency will pay half of the cost and it will be repayable from production.

WYOMING

Colorado Fuel & Iron Co. has laid off 26 men at its Sunrise mine and out the work week to four days because of a slackening demand for iron ore at its Pueblo, Colo., blast furnaces.

The mine had been operating two shifts 5 days a week and cut its operation to 4 days a week.

Lucky Mc Uranium Corp. has started mining its 1-A pit in the Gas Hills. The 1-A pit is located in approximately the same place as the original Lucky Mc mine. The small pit located to the Southeast of the main 1-A pit has been mined out.

Recent exploration and drilling in the Gas Hills and Crooks Gap uranium districts of Fremont county have increased proven reserves in central Wyoming to an estimated 18- to 20-million tons.

Mining leaders in the Riverton area estimate there is probably 20- to 30-million tons and possibly 40-million tons if the present discovery rate is a reasonable criteria.

The latest AEC estimates listed the Gas Hills and surrounding areas with reserves of 10-million tons.

Currently only 1,150 tpd milling capacity is authorized by the AEC, but five firms are seeking AEC approval to construct new mills or expand existing ones.

More than 354,000 cubic yards of dirt overburden are being removed in development of a huge new open pit uranium mine by Vitro Minerals Corp. in the East Gas Hills area of central Wyoming.

The mine is on the Pix claims, acquired by Vitro from Veca Minerals in July.

Platte Chemical Co. of Salt Lake City has purchased a site east of Casper for location of a sulphuric acid plant. The site is near the Burlington railroad tracks.

The proposed plant is estimated to cost about $2.5 million.

The state of Wyoming's royalty on uranium produced onstate-owned lands more than tripled in the first nine months of 1957 as compared with a similar period a year ago.

Uranium royalties for the first 9 months of 1956 amounted to $2,645, compared with $8,135 for the same period of 1957.

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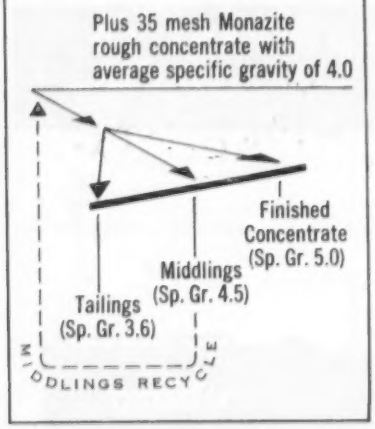
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SEPARATIONS

Wyoming *(Continued)*

Ben Cossman said leasing of state lands for uranium mining brought in $151,850 in 1956 and only $100,083 for the first nine months of 1957.

Wyoming Mining Association will hold its third annual convention in Casper April 17, 18 and 19.

H. Darby Hand, of the firm of Jenkins and Hand of Casper and secretary-treasurer of the state association, is general chairman of the convention committee.

Inquiries concerning space for exhibits and the floor plan should be directed to the Wyoming Mining Association, Box 1230, Riverton, Wyo.

Continental Uranium of Wyoming has launched the first major underground uranium mining operation in the state.

Continental is working the Seismic claims in the Crooks Gap area both by open pit and underground operations. Continental is one of the largest producers in the Crooks Gap areas on claims obtained from Gaddis Mining Co. last year.

IN CANADA

ONTARIO

The mill at the Blind River uranium producing property of Can-Met Explorations is currently handling from 1,000-1,100 tpd. The rate is being gradually built up to 1,500 tons by year end and to 3,000 tons by the end of May 1958. Mill operations were started mid-October. An additional source of ore was disclosed in a secondary zone located in shaft sinking and this zone has been providing about 800 tpd mill feed. The zone has averaged about 2.0 lb uranium oxide across an average thickness of 5.5-6.0 ft.

Faraday Uranium Mines, Bancroft area, has received increase in its sales contract with Eldorado Mining and Refining from $29,754,800 to approximately $45-million. The increase is to take care of ore shipments from the nearby property of Greyhawk Uranium Mines. Under the contract Greyhawk is to ship ore containing 1,640,000 lb uranium oxide to Faraday. Faraday is to pay from $4.50 to $7 per lb of contained uranium oxide depending on grade. [Greyhawk has gradually stepped up the pace of shipments. In August 2,700 tons was shipped, in September 4,000 tons, and during October approximately 200 tpd.]

Construction program at the Bancroft area uranium property of Canadian Dyno Mines is being held to schedule. It is anticipated that the production target date of early April 1958 will be achieved. Since completion of shaft to depth of 1,000 ft over a year ago, development work has been progressing on the five levels established at 150-ft intervals. Surface drilling indicated about 2,250,000 tons grading 0.093% uranium oxide in three zones after allowing for 12.5% dilution. Additional ore has been indicated in downward extension of these zones and in other zones.

A premium price contract with European steel interests has been obtained by Arcadia Nickel Corp. for the sale of its entire nickel output in 1958 from its property on the Worthington Offset, some 20 miles from Sudbury. Agreement has also been concluded for smelting and refining of its concentrates in Canada. Property is slated to be in production within the next three months at a rate of 1,000 tons per day.

QUEBEC

Canadian National Railway has opened the first of its two lines into the Chibougamau copper camp. First branch to be completed was the 158-mile line from Beattyville in the Amos-Barraute area. The second branch of about 135 miles, will come into Chibougamau from St. Felicien to the south. Producers in the camp have been shipping copper-gold

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Quebec (*Continued*)

concentrates over the new line for some months already. Opemiska Copper Mines was the first spot reached by the railway and shipments were started shortly thereafter. Other shippers are Campbell Chibougamau and Anacon Lead Mines' Chibougamau Explorers property.

Merrill Island Mining Corporation expects to have its new 650-tpd capacity plant at the Dore Lake Chibougamau property in operation early in January. The company will be the fourth copper-gold producer in the area. Underground development and stope preparation have been concentrated in recent months in both the "A" and "B" ore zones on the 150 and 300-ft levels. Normal development is also being done on other levels to 925 ft. Originally the "A" and "B" were calculated to contain 1,022,000 tons averaging 2.05% copper down to the 300-ft horizon.

Newmont Mining Corp. through its wholly-owned Canadian subsidiary, Newmont Mining Corporation of Canada, has obtained a large interest in the Mattagami area, the scene of an important zinc-copper discovery earlier this year. The company has taken option on a block of 400 claims spread across two townships, plus a group of 30 claims a short distance to the south.

Shaft sinking at the Chibougamau area copper property of Copper Rand Chibougamau Mines is to be continued from its current depth of about 850 ft to 1450 ft. Work is expected to be completed by next spring. Operations at the adjoining Chibougamau Jaculet Mines are to be suspended at the end of 1957 until the milling plant at Copper Rand is completed. The plant is scheduled for operation in March 1959.

BRITISH COLUMBIA

Potential of a new copper-iron discovery on the Highland Valley property of Craigmont Mines Ltd., may be in excess of 100-million tons. Consulting engineers to the company say development of property would warrant a pig-iron plant and concentrator.

The discovery, this year's largest in British Columbia, was made after two months of soil and magnotometer testing. Craigmont consulting engineer R. E. Renshaw told *E&MJ* that tests showed about 15-million tons averaging 1.2% copper and 30% iron, and that total potential of the same grade is expected to be 100-million tons.

Full scale exploration is to be carried out immediately. The company is negotiating with an unnamed major American copper firm for exploration and production programs and the Mannersman steel pipe company of Germany has approached the Vancouver firm for supplies of pig-iron. Renshaw said results of negotiations were to be known sometime in November.

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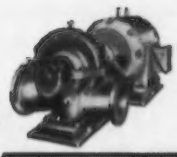

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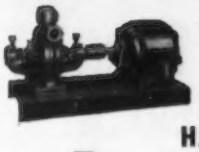

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British Columbia *(Continued)*

known rich ore deposits at Silverton, has embarked on an 18-month $250,000 program.

A new 2,500 ft tunnel will be driven 400 feet below the present number nine level. It is here that the known ore deposits will allow the company to recoup the expenditure in a short time as the ore is very rich.

MANITOBA

Hudson Bay Mining & Smelting Co. reports net profit for the first three quarters of 1957 amounted to $6,669,950, of $2.42 per share compared with $17,038,794 or $6.18 per share earned during the like period a year ago. Reduction in profit was due to the drastic decline in metal prices. In the Snow Lake area, the company has proven up a substantial tonnage of copper-zinc ore with shafts being sunk at Schist and Stull Lakes. The survey of a rail line to connect Snow Lake with the Sherridon branch of the CNR is to be carried out this winter. Actual construction may start in 1958.

San Antonio Gold Mines Ltd., Manitoba's veteran gold producer, is stepping up development work on the 24th level to intersect ore previously found on the 22nd and 23rd levels. A marked improvement in the labor situation has made this possible. The mill is currently handling between 375 and 400 tpd.

IN LATIN AMERICA

CHILE

Compagnie Miniere du M'Zait has been active in developing its copper mines at Melon, near the town of Calera, half way between the port of Valparaiso and Santiago. First the El Soldado orebody was opened up about 1930 and a 450 tpd mill built at El Cobre, 1½ miles down from the mine. Then the Las Guías deposit was found to the South and later the Santa Clara portion was developed still further to the South and near the well known vein of Veta del Agua now owned by Mauricio Hochshild interests which have been drilling around the high-grade copper vein. The El Cobre flotation mill has been brought up to 700 tpd capacity and there has been talk of installing another two large ball mills and the necessary crushing and flotation machinery to increase milling capacity by another 2,000 tons.

Price of Chilean nitrate has been upped $1.75 to $46.27 per ton in bulk and $49.75 sacked in 100 lb bags.

Mining, including nitrate, supplies Chile with 87% of its foreign exchange of which 74% is earned by copper mining and 13% by nitrate. The output of nitrate which faces a severe competition from synthetic compounds, fell from 1,540,000 metric tons in 1955 to 1,160,000 tons last year, a reduction of 25%.

Mining Credit Bank and the Administration as a whole are interested in preventing a complete shutdown of the medium and small mines, the great majority of which are engaged in producing copper, because though individually small, in the aggregate they furnish the country with over $50-million in foreign exchange per year.

ARGENTINA

A tungsten concentrating plant, purchased in the United States, is now being installed in Valcheta, Patagonia. The plant whose annual capacity is 250 tons of tungsten concentrate is the first of its kind in Patagonia. It will benefit small producers in that remote area by avoiding transportation costs for the ore.

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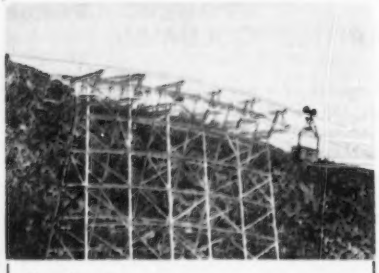

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Argentina *(Continued)*

Plans for the creation of an Argentine Banco Minero—Mining Bank—are completed, the Subsecretariat of Industry has announced.

The new Bank will be modeled on the similar institution in Chile, which has had signal success. Operating within the framework of the Argentine official bank system, the Mining Bank, due to the peculiar credit needs of the industry will, according to spokesmen from the Subsecretariat, stress the technical aspects in granting loans.

BRITISH GUIANA

African Manganese Co., London, has awarded a $7-million contract for construction of a 38-mile railroad from its manganese deposit in the interior of British Guiana to head of navigation on the Kaituma River.

When the project is finished—in two years—the firm will begin shipping ore by rail to a point on the Kairuma where it can be transferred to barges. It will be barged as far as Trinidad, then transshipped to Newport News, Va.

The railroad will be built by J. H. Pomeroy & Co., San Francisco contracting firm.

IN THE PHILIPPINES

Lepanto Consolidated shipped 9762 tons of copper-gold concentrates to Tacoma in September, containing 27.1% copper and 0.8 oz gold per ton. This was the company's 76 post-war shipment to the U. S. During the month, Lepanto milled 35,262 tons of ore averaging 3.4% copper and 0.112 oz gold per ton. Total production was 2,286,840 lb copper in concentrates and 3,092 oz gold. Nevertheless, current low earnings caused by the sharp decline in copper prices, have compelled the directors to pass any cash dividend for the third quarter of the year. It was pointed out that inflation had increased costs, which had not been offset by an increase in production.

Base metal producers have asked government assistance during the present period of low prices. The president has appointed a committee to study the matter. It is hoped the copper producers might receive reduced tariff duties on imported supplies. Gold producers have been subsidized for several years. Last year the Gold Subsidy Board paid out $9-million to 13 good mining companies and the Central Bank also aided by permitting them to sell part of their output at favorable open market prices, particularly to holders of blocked pesos.

Palawan Consolidated shipped 2,200 tons

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Philippines *(Continued)*

of chromite ore to Europe, valued at $116,000 in October. This makes the first shipment of metallurgical and chromite into the European market. Another shipment is scheduled for November.

During the first six months this year Consolidated Mines shipped 304,478 tons of refractory grade chromite to U. S., valued at over $5.9-million. This was slightly more than in the same period last year.

Hixbar Mining Co., operating a copper property on Rapu Rapu Island, Albay, delivered its first carload of ore to the flotation mill. Karl Landahl is president of the company, which had a substantial output of direct shipping ore to Japan before the war.

Benguet Exploration Co. had its first production of gold from its Thanksgiving mine in the Baguio area in September. The property is operated by the Philex Mining Corp. Ore milled averaged $29.90 per ton.

IN AUSTRALIA

A company has been established in New Zealand to investigate the establishment of an iron and steel industry based on the possible exploitation of huge deposits of iron sands.

Acting chairman of the new company is W. J. R. Scollay, who is the New Zealand representative of Philipp Bros. Ore Corp. of New York.

Present plans provide for initial smelting of about 500,000 long tons of North Island iron ore from West Coast iron sands deposits. These deposits are conservatively estimated to be in the vicinity of 700-million tons.

Calculations are being based on an extraction rate of 60% iron, 5% titanium, 0.3% vanadium and some thorium.

Big Australian producers of lead and zinc feel that it is imperative to speed up the development of new uses for lead and zinc and that American efforts in this direction should obtain a massive backing from producers in other countries.

Value of production of the Australian mineral industry in 1956 reached a record figure of $550-million, an increase of about 25% on previous year's figure. Metal and mineral exports, excluding gold, were worth about $190-million and the lead-zinc industry contributed about 70% of export value. Current year's figures are expected to be lower because of a drop in prices of several metals and a decrease of activity in the mineral beach sands industry.

Rio Tinto Mining Co. of Australia has started drilling activities on the Savage River iron ore field near Waratah in Tasmania. Difficult terrain and the inaccessibility of the deposit forced the company to transport equipment and supplies by helicopters. Large reserves of commercially important iron ore are suggested and the "anomaly areas" resemble closely those in the great magnetic iron deposits in Sweden. Two "anomaly areas" have been disclosed, each several thousand feet long, up to 500 ft wide and many hundreds of feet deep.

Australian imports of tin will be increased by at least 1,000 tons per year to meet the demand on the part newly-opened tinplate industry. Efforts are being made to obtain Federal Government's assistance to the local tin mining industry which claims that it can open up new deposits and extend old ones provided assistance is granted to this industry as is the case with gold and uranium industry.

Peko Mines N. L., copper and gold producer, has arranged for local treatment of considerably greater part of its production of copper. It may reduce, or possibly even discontinue production for export because of low copper price in world markets. Throughput has increased to 300 tons a day and is scheduled to reach 400 tons a day in December.

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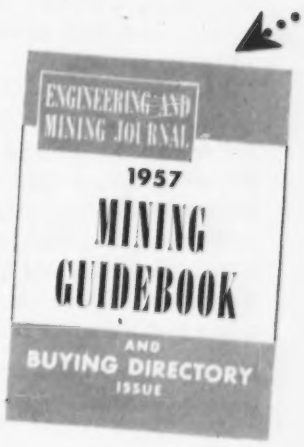

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Illustrated here are four simple steps to take when installing Bethlehem Square-Head Roof Bolts. Regardless of the length and diameter of the bolts used, this procedure enables the job to proceed at a steady pace, and helps materially in minimizing installation costs.

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We recently issued an interesting 20-page illustrated catalog on roof bolting. If you would like to have a copy for reference, all you need do is drop a line to the nearest Bethlehem sales office.

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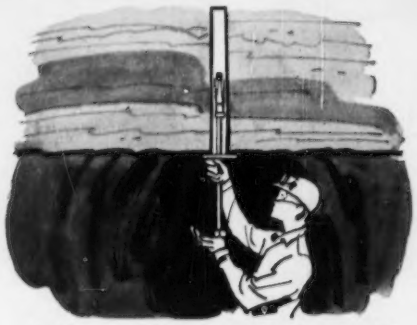
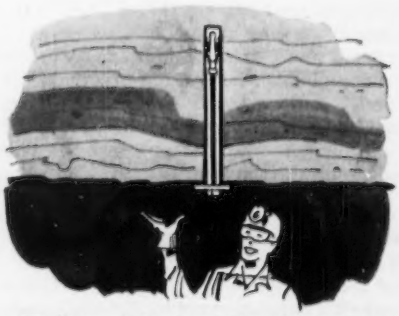
BETHLEHEM STEEL

1 Using regular drilling equipment, the hole is drilled to required depth.



2 The assembly, consisting of roof bolt, square roof plate, malleable-iron shell and steel plug, is inserted in the drilled hole.

3 Bolt head is tightened with power wrench. This draws down the plug, expanding serrated leaves of shell.



4 The shell is anchored securely. Square roof plate furnishes additional support. Steel ties, connecting a series of holes, may be substituted.

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THE BEGINNING OF THE FILM FOR
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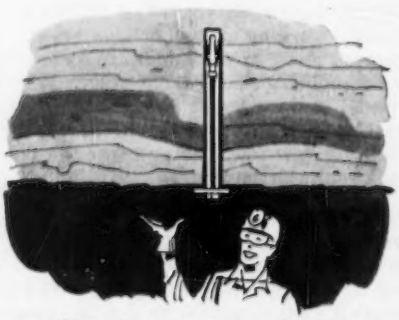

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1—40 HP Vulcan #22C
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1—50 HP Vulcan
1—50 HP Box
1—75 HP Vulcan
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2—150 HP Vulcan
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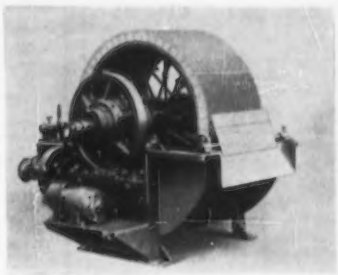

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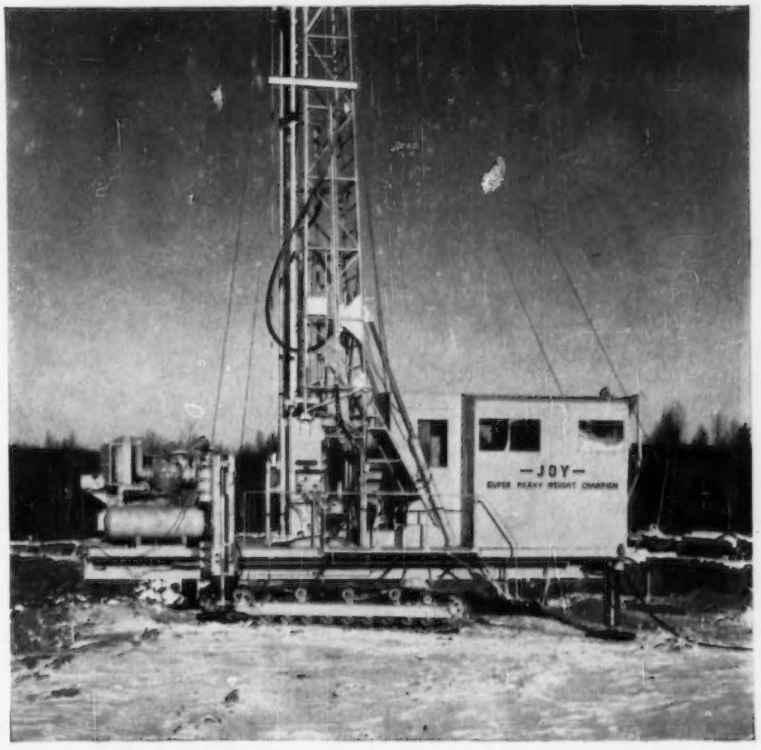

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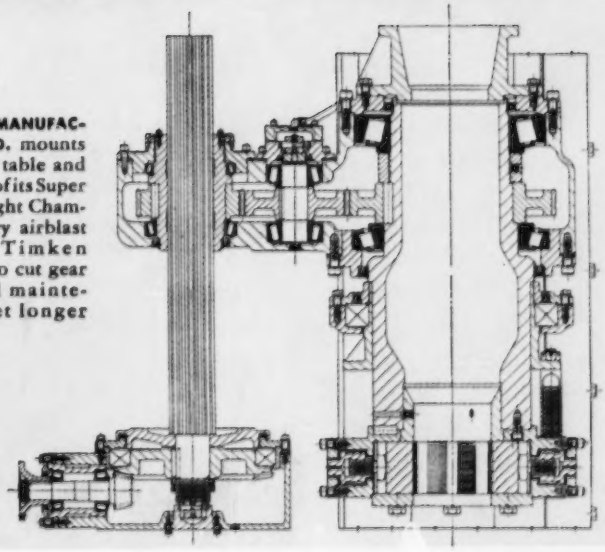

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